A FEASIBILITY STUDY OF RENOVATION OF SEWAGE LAGOON EFFLUENT BY RAPID INFILTRATION

VILLAGE OF MARKDALE

September, 1980

Ministry of the Environment
Ontario

THE ONTARIO MINISTRY OF THE ENVIRONMENT

A FEASIBILITY STUDY OF RENOVATION OF SEWAGE LAGOON EFFLUENT BY RAPID INFILTRATION VILLAGE OF MARKDALE

by

B. Novakovic

Southwestern Region
Technical Support Section
Water Resources Assessment Unit
London

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We know accurately only when we know little,
with knowledge doubt increases.

Johann Wolfgang von Goethe (1749-1832)

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SUMMARY

The area located immediately south, southwest and west of the Markdale sewage lagoon consists of gravel and sand with some silty and clayey sections. These granular deposits are of glaciofluvial origin. A portion of this land about 60 to 70 m wide situated along the Rocky Saugeen River is wet with small sections of cattail environment, consisting of peat deposits. This wet area along the Rocky Saugeen River is considered a discharge zone of the shallow water table and bedrock aquifer systems. The coefficient of permeability of sand and gravel deposits, 15 m in thickness is about 0.4 cm/s.

In general, the width of the area between the lagoon and the Rocky Saugeen River is about 300 m and it offers an excellent opportunity to achieve tertiary treatment of sewage lagoon effluent by infiltrating the effluent into the porous sand and gravel deposits.

A rapid infiltration study was conducted to determine the feasibility of sewage lagoon effluent treatment by means of groundwater recharge. If feasible, it would eliminate direct discharge of the effluent into the Rocky Saugeen River and thus maintain its high quality.

The study lasted from October 19 to November 26, 1979 during which time approximately 8,000 m^3 of sewage lagoon effluent was infiltrated into the granular deposits. In actuality only 27 days were inundation periods during which the average recharge rate was 3.46 L/s. A conservative calculation indicates an average hydraulic loading of 24.91 $m^3/d/m^2$.

The field installation consisted of a recharge basin with a controlled infiltration area (12 m^2). Numerous observation wells and test pits were located at strategic locations in close vicinity to the infiltration basin. They were used to measure water level response to infiltration and to obtain water samples for qualitative analyses.

A slight reduction of infiltration rate appears to be due to gradual clogging of the bottom of the infiltration basin caused by deposition of suspended solids present in the sewage lagoon effluent. This clogging, generated by physical factors,affected only very shallow soils (5 cm) at the bottom of the basin.

The results of qualitative analyses indicated that the dissolved reactive phosphorous was reduced to background levels a short distance from the infiltration basin. The components of the nitrogen cycle were converted into nitrate and a considerable amount of nitrogen was reduced at a relatively short distance from the infiltration basin.

Other chemical constituents present in the sewage lagoon effluent were attenuated by the subsurface environment to various degrees depending partially on the distances from the infiltration basin.

Chemical constituents of the sewage lagoon effluent which may reach the groundwater discharge area will undergo further attenuation by biological and microbiological processes while travelling overland through wet environments before entering the Rocky Saugeen River.

The quality of this small portion of the sand and gravel aquifer which received waste water from the lagoon during the rapid infiltration study can be allowed to deteriorate since it has no prospective use in the future.

In summary, the results of this study are quite encouraging. They provide sufficient background information and preliminary criteria for the design of an operational system with infiltration basins.

INTRODUCTION

This report summarizes the results of a study of sewage lagoon effluent treatment by utilizing mainly hydrogeological, biological and hydrological environments. Two basic aspects are briefly addressed in this study; (a) hydraulics of the receiving aquifer and (b) renovation of the effluent while moving through granular materials.

Other aspects of a recharge system such as design criteria, infiltration system management, winter operating constraints, etc. are also discussed.

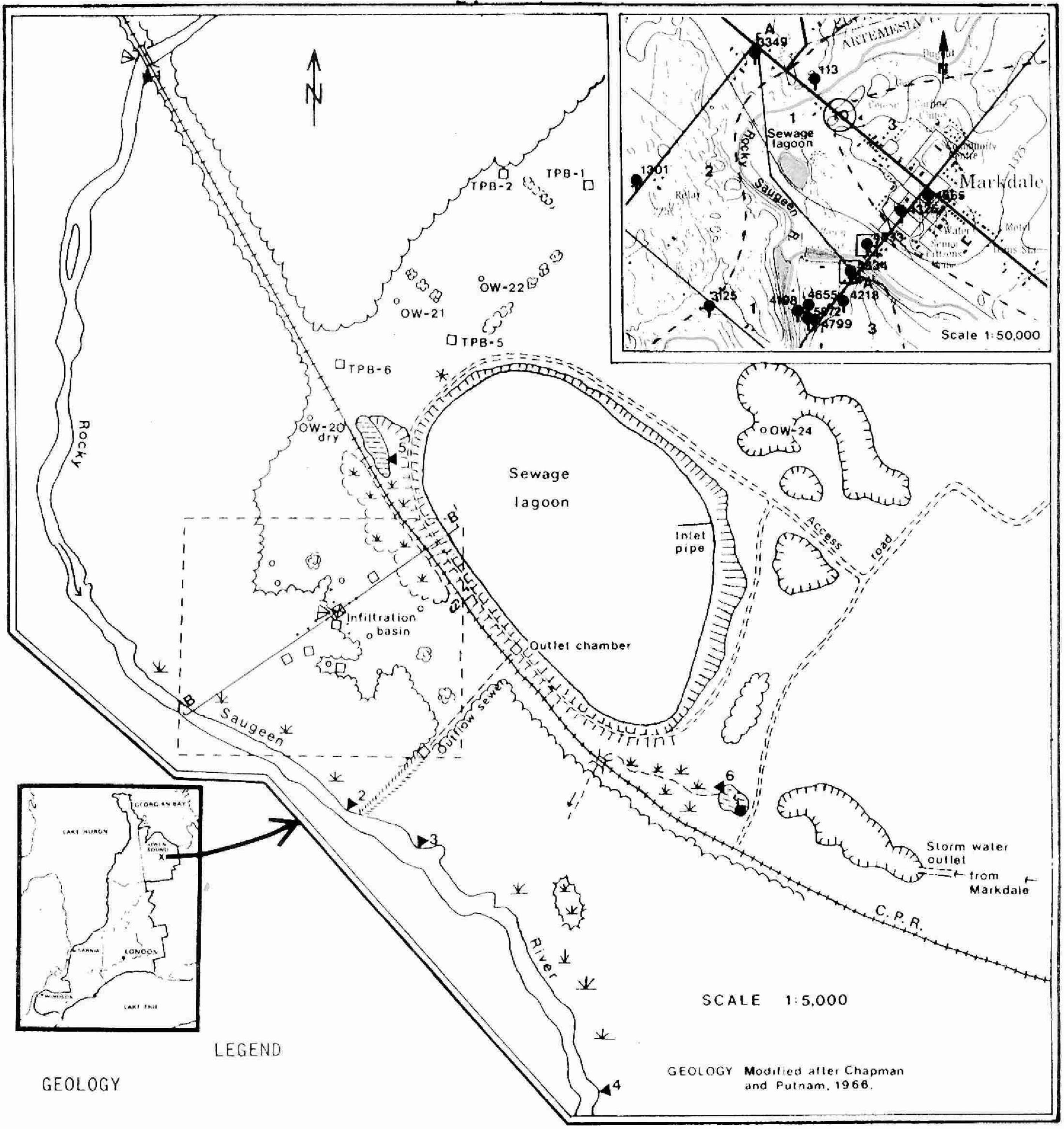
Objectives of the Study

The main objective of this study was to examine the possibility of utilizing hydrogeological environments for treatment of sewage lagoon effluent by means of a recharge basin.

Furthermore, the results of the study (if favourable) would be useful in establishing preliminary design criteria for a full scale operational system to treat sewage lagoon effluent by rapid infiltration.

Background

The Village of Markdale is presently serviced by a facultative one-cell lagoon system 5.67 ha in size (Figure 1 and Photo 1). The lagoon effluent is discharged in the spring and fall to the Rocky Saugeen River located about 170



LEGEND

GEOLOGY

Quaternary

1	Spillway; mainly gravel sand, silt
2	Kame moraine; sand silt, gravel, clay
3	Till plain (drumlinized)

SYMBOLS

- Geological boundary (approx.)
- A A' Location of cross-section
- 1301 Bedrock well with MOE well record number
- 4533 Municipal well # 1
- 4534 Municipal well # 2
- Surface water sampling point
- Stream gauge station
- Rain gauge station
- TPB-6 Test pit (backfilled)
- OW-22 Observation well
- Area of intensive study detailed in Figure 2
- Spring

FIGURE 1. Location and surficial geology map.

m from the lagoon (Photo 2). From the control manhole, the effluent is directed by a 131 m long 20.32 cm diameter buried pipe and subsequently by an open ditch to the River (Figure 1).

A water quality survey of the Rocky Saugeen River carried out by staff of the Ministry of the Environment during the fall discharge of the lagoon effluent (MOE, 1979) showed a measurable effect on the river water quality to a considerable distance downstream from the sewage outfall.

The Rocky Saugeen River is a high quality stream which supports salmonid species. Therefore, there are concerns that expansion of the present mode of lagoon operation may have a significant impact on the stream water quality. In view of this, coupled with the fact that the present sewage treatment facilities are at capacity, this Ministry requested that the Village of Markdale look into other options (exfiltration) of improving sewage treatment facilities.

Subsequently, the Village engaged the consulting firms, Henderson, Paddon and Associates Limited and Morrison Beatty Limited to carry out the study.

This initial study by the Village's consultant was carried out in the summer and early fall of 1979. When funds for the feasibility studies were exhausted, the Ministry of the Environment, Southwestern Region, decided to apply staff resources to continue the work in order to take advantage of the experimental system that had been established.

Photo 1. A portion of the Village of Markdale sewage lagoon looking east. Village of Markdale is in right background. Pumping equipment is sitting on the control manhole at the extreme lower right margin.

Photo 2. Looking downstream, Rocky Saugeen River immediately upstream of the lagoon effluent discharge (arrow).

Location

The study area is located about 900 m west of the Village of Markdale, in Lots 94, 95 and 96, Concession I West of Toronto - Sydenham Road, Glenelg Township, Grey County. More precisely, the land of intensive study is situated between the Markdale oxidation pond and the Rocky Saugeen River (Figures 1 and 2).

Figures 1 and 2 also give the locations of monitoring stations and field instrumentations used in this study.

Access to the study area is provided by the access road to the sewage lagoon which is also used to transport sand and gravel extracted from the pit located immediately northeast of the lagoon (Figure 1). The study area is about 900 m from the provincial highway 10.

The study area is traversed by the Canadian Pacific Railway (Toronto - Owen Sound line).

Topography

The area of intensive study is situated on relatively flat ground of the Rocky Saugeen River valley bottom, which in this area is about 300 m wide. There is about 6 m difference in elevation between the river and the "highest ground" which is actually a very small ridge running parallel to the river between 150 and 180 m away. The infiltration basin was located near the extreme southern flank of the ridge's crest (Figure 1).

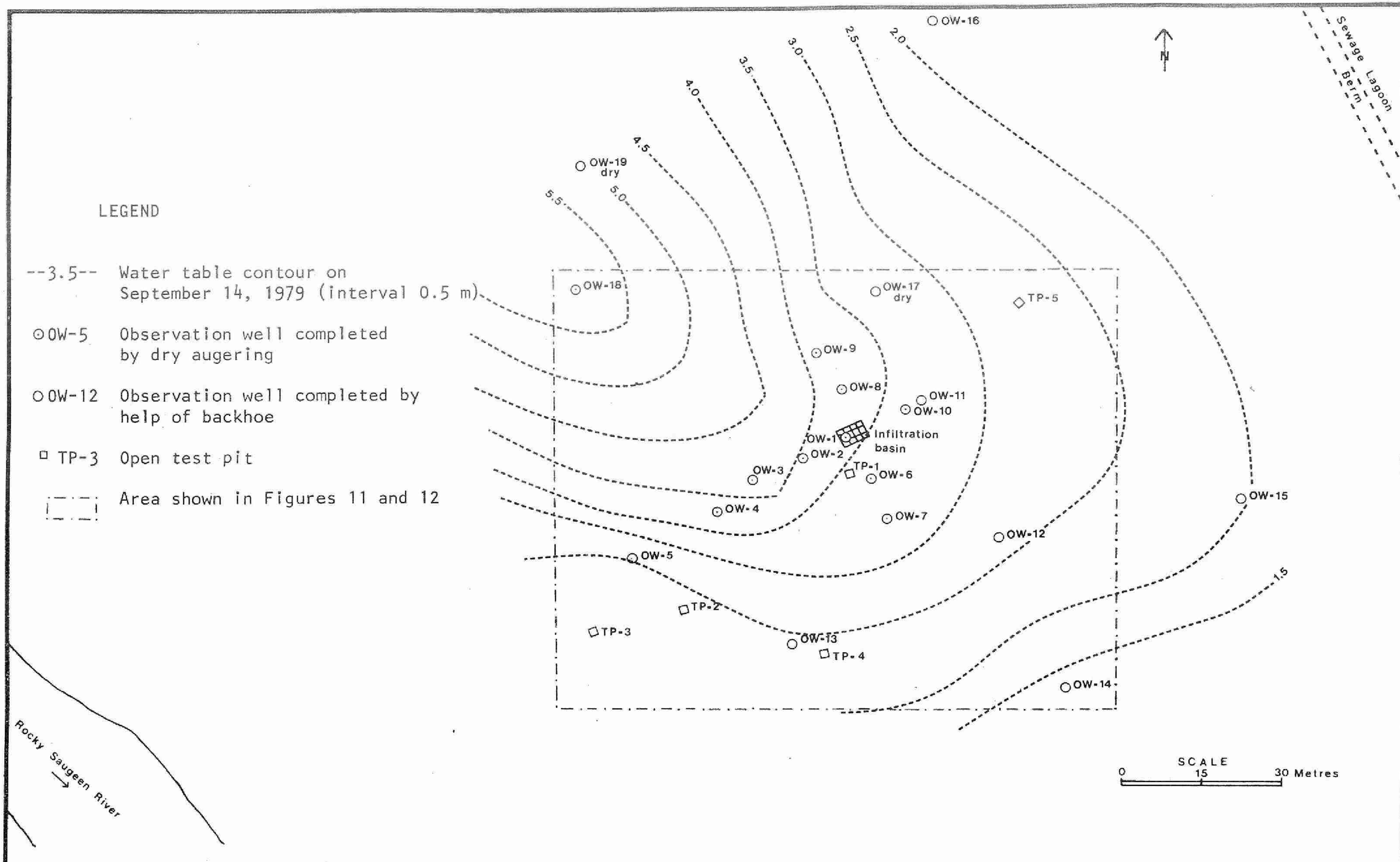


Figure 2. Map showing the depth to original water table and identification of monitored observation wells and test pits.

In general, the area between the river and this minute ridge is overgrown by cedar trees, whereas in other sections occasional cedar trees and willows can be found particularly in the wet portion (Photo 3).

Drainage

The Rocky Saugeen River is deeply incised into the local glacial deposits and any associated drainage system and runoff are directed into the River which is a focus for surface and groundwater discharges.

There is very little surface water runoff occuring after intensive rainfall and snowmelt, because most rainfall infiltrates quickly into the permeable soil. A minor stream rises southeast of the lagoon fed by the natural spring-pond system and periodically by the discharges of storm water released into the former gravel pit some 130 m away (Figure 1). After passing the CPR tracks, this flow disperses into a mucky, wet environment.

A second permanent pond is located immediately northwest of the sewage lagoon (Figure 1). This pond is an integral part of a low lying wet and occasionally water covered strip of land about 25 m wide running parallel to the CPR tracks, but on the opposite side of the tracks from the lagoon.

Another wet and low lying area, overgrown by cedar trees about 60 to 70 m wide, is situated along the Rocky Saugeen River. In this section of land, black peat and small cattail environments are commonly found (Photo 4).

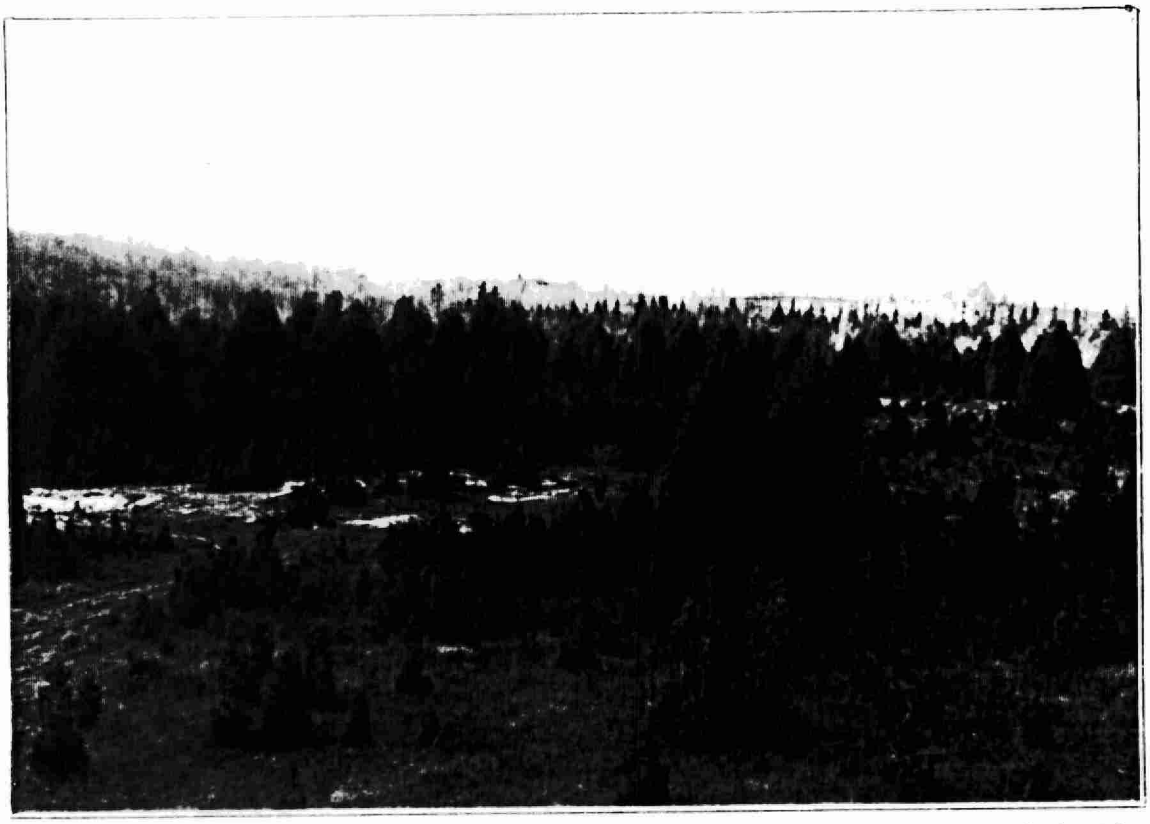


Photo 3. A portion of the study area looking west, with the recharge basin at the extreme left - centre. The boundary between coniferous and decidious trees at left marks the position of the Rocky Saugeen River.

Photo 4. A section about 60 m wide consisting of wet peat deposits with minute cattail environments are present along the Rocky Saugeen River.

Previous Investigations

In connection with the proposed sewage system construction, William Trow Associates Limited (1966) investigated geotechnical conditions in the Village of Markdale and at the property now occupied by the sewage lagoon.

Hydrology Consultants Limited (1973) carried out test pumping and an evaluation of hydraulics of two municipal wells which are now water sources to the Village of Markdale.

Preliminary reconaissance work, including excavation of 16 test pits and construction of all field installations for groundwater monitoring except for TP-1 to TP-5 inclusive, staff gauges and rain gauge was carried out by Morrison Beatty Limited (1979). This work also included a 24-hour recharge test taking water from the Rocky Saugeen River as a recharge source and a 6-hour infiltration test using sewage lagoon effluent pumped directly from the lagoon. The results of their efforts were summarized in a brief report.

Field Work

The field investigation lasted from October 18, 1979 to November 26, 1979. The field work among other things included:

1. Installation of two staff gauges, rain gauge and construction of five test pits left open.

2. Pumping of the sewage lagoon effluent by a gasoline driven pump into the infiltration (recharge) basin.

3. Very frequent sewage flow measurements and maintaining and recording of a constant height of wastewater in the infiltration basin.

4. Frequent water level (at least twice a day) measurements in observation wells and test pits.

5. Daily checking of rain gauge station and staff gauge in the Rocky Saugeen River.

6. Collection of numerous water and wastewater samples for qualitative analyses.

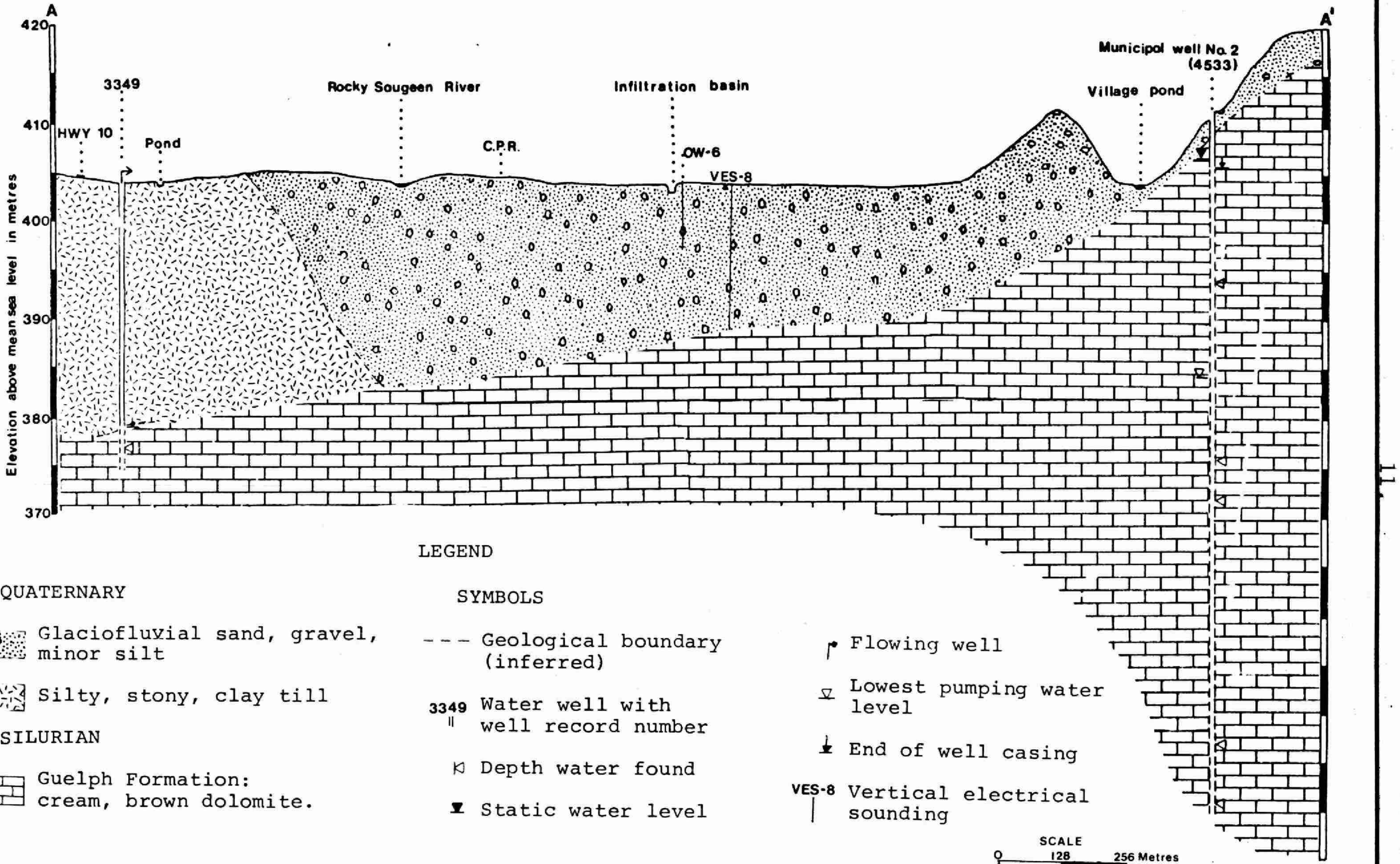
7. Collection of soil samples for mechanical analyses.

8. Performing a dye test in order to establish underground retention times of the renovated water.

Field Installations

The location of the field installations is given in Figures 1 and 2. Stratigraphy, depth and some details concerning the construction of observation wells and test pits is given in Appendix A.

A recharge basin located about 160 m distance from the pump intake was specifically constructed for the purpose of this study. The side and marginal sections of the basin bottom were lined with polyethylene so that the dimensions of the infiltration area were 3 X 4 m (12 m^2). The slope ratio of the side was 1.5:1 and depth was 0.83 m.



LEGEND

QUATERNARY

Glaciofluvial sand, gravel, minor silt

Silty, stony, clay till

SILURIAN

Guelph Formation: cream, brown dolomite.

SYMBOLS

--- Geological boundary (inferred)

3349 Water well with well record number

Depth water found

Static water level

Flowing well

Lowest pumping water level

End of well casing

VES-8 Vertical electrical sounding

SCALE

0 128 256 Metres

Figure 3. Vertical cross-section A-A' showing geology and hydrogeology in the general area of investigation.

About 20 to 30 cm of the original granular material at the bottom of the recharge basin was replaced with borrowed, well-sorted sand and gravel.

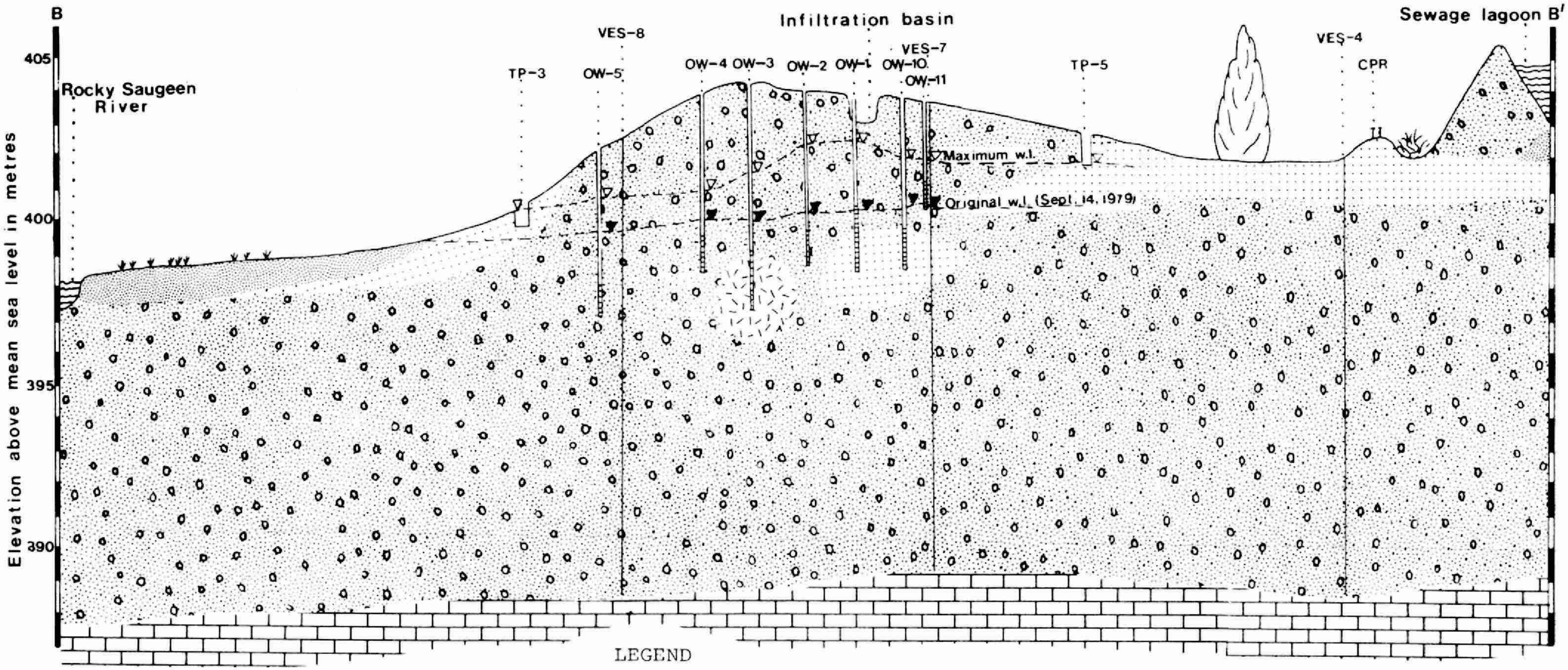
The hypsometric position of the infiltration basin and its relationship with the nearby piezometers is shown in Figures 3 and 4.

There were 11 observation wells (OW-1 to OW-10 inclusive and OW-18) constructed using dry augering techniques, all located in the vicinity (positioned in a cross-like fashion) of the recharge basin. Other observation wells installed with the help of backhoe and five open test pits (TP-1 to TP-5 constructed on October 29, 1979) were also located in close proximity to the basin (Figure 2).

One observation well (OW-1) along with a staff gauge were constructed right in the infiltration basin.

All piezometers were made of PVC pipe 5.71 cm in diameter with 1 to 2 m slotted sections at the bottom. The length of a single slot was about 15 mm, width of slots about 1 mm and slot spacing about 75 mm for OW-1 to OW-10 and OW-18. For the rest of the observation wells the slot width and spacing were irregular. A protective cup was placed at the bottom of the pipe as well as a bentonite clay plug near the surface for OW-1 to OW-10 and OW-18.

The majority of observation wells (OW-1 to OW-18 except OW-17 which was dry) and test pits (TP-1 to TP-5) were frequently used to measure the hydraulic response of the water table aquifer to recharge, and they also provided access to the water table to obtain water samples for qualitative analyses.



LEGEND

QUATERNARY

Black peat

Sand and gravel, minor silt

Sand and gravel, some silt, clay

Clayey silt till

SILURIAN

Guelph Formation: cream brown dolomite

SYMBOLS

- - - Lithological boundary (inferred)

OW-2 Observation well

VES-7 Vertical electrical sounding

TP-5 Open test pit

Slotted well section

SCALE

0 15 Metres

Figure 4. Vertical cross-section B-B' showing geology and hydrogeology in the study area and hypsometric position of the recharge basin.

A flowmeter was placed a few metres away from the effluent outfall into the recharge basin. A temporary rainfall gauge was installed at the site as well as two staff gauge stations; one was installed in the recharge basin and the second in the Rocky Saugeen River, under the CPR bridge (Figure 1).

GEOLOGY AND HYDROGEOLOGY

Bedrock Geology

Nowhere in the study area does the bedrock outcrop. In the southwestern section of the Village of Markdale at municipal well No. 2 the bedrock is found near the ground surface overlain by about 1.2 m of granular deposits. The bedrock within the study area, and in the wider area as well, is of Middle and Lower Silurian age. It has been ascribed to the Guelph Formation which consists of dolomite. The dolomite is typically massive bedded, white, blue or brown in colour, fine to medium crystalline and highly porous.

The Guelph Formation may be seen in the Rocky Saugeen River bank at the intersection of Grey County Road 12 and associated side road some 1500 m from the study area.

Figures 3 and 4 show the hypsometric position of the bedrock within the study area and in the broader area outside of this investigation. Information from the geophysical survey indicates that the bedrock in the study area is overlain by 13 to 15 m of glacial deposits.

Surficial Deposits

The distribution of unconsolidated deposits is given in Figure 1 (inset map). Numerous excavated test pits and boreholes augered in the study area confirm that the overburden basically consists of sand and gravel, with minor silt and clay (Appendices A and B; Photos 5 and 6). In some

Photo 5. Silty sand and gravel exposed in the test pit excavated at OW-1.

Photo 6. Sand and gravel with very little silt at OW-20.

sections, along with sand and gravel there are cobbles with minor boulders. Granular deposits of reduced permeability consisting of silty sand and gravel with minor clay fractions are present in the low area along the CPR tracks (opposite from the lagoon) and on both sides of the sewer outflow line (Figure 1). This material is most likely present in the lowland area along the Rocky Saugeen River where it is overlain by peat deposits (Figure 4, Photo 4).

Three boreholes (OW-3, OW-6 and OW-7) intercepted poorly permeable material (clayey silt till with some pebbles) at a depth of 4.9 and 5.8 m respectively. This initial information suggested that the sand and gravel deposits may be underlain by poorly permeable material separating it from the bedrock. However, a subsequent geophysical resistivity survey (electrical sounding) carried out in May, 1980 indicated that the surficial deposits mainly consist of sand and gravel (Appendix C). Directly overlying the bedrock formation, these deposits are about 15 m thick in the study area. Because it is not possible to distinguish between sandy silt till and sand and gravel on the basis of resistivity survey, it is quite conceivable that a silty till underlies the sand and gravel, thus separating it from the bedrock. It is also possible that sections of poorly permeable material less than 3 m in thickness which cannot be delineated using the electrical sounding technique may be present within the deeper portion of glacial deposits. Information from three boreholes (OW-3, OW-6, and OW-7, Appendix A) support this hypothesis.

The peat deposit is present in the low lying area along the Rocky Saugeen River in the zone about 60 to 70 m wide (Photo 4). Its thickness is unknown, however, a test hole dug in the present lagoon area reported the presence of 1.8 m of peat.

Hydrogeology and Groundwater Movement

Bedrock Aquifer System

The porous bedrock dolomite constitutes a high capacity aquifer system which is the source for two municipal wells and for many domestic wells in the broad area of investigation.

Permeability of the bedrock formation is due primarily to chemical dissolution of the dolomite along ancient weathered zones, fractures and bedding planes. Because this dissolution can produce a large variety of opening sizes and patterns, permeabilities in the bedrock vary widely. In general, the bedrock appears to be most permeable within 6 m of its upper surface.

In the broader area of investigation (inset map in Figure 1) the potentiometric head in the bedrock aquifer, as obtained from water well records, is higher than the Rocky Saugeen River bed. This strongly suggests that the groundwater movement in the bedrock is towards the river from both sides with the river being the discharge zone of the bedrock aquifer system.

Sand and Gravel Aquifer

All boreholes penetrated into the saturated zone in the surficial deposits. Only three test pits were not deep enough to reach water table (OW-17, OW-19 and OW-20).

Depths to water table in the area of intensive study vary considerably depending on the topographic configuration. In the small ridge area northwest of the recharge basin the depth to water table is over 5.5 m (Figure 2) whereas in the low lying area along the river, it is at the ground surface.

Groundwater flow direction in the shallow water table aquifer is strongly influenced by topography (Figure 5). The flow is to the southwest with the Rocky Saugeen River being the focal point - the discharge zone of both the overburden and bedrock aquifer systems.

Permeability of Surficial Deposits

Two basic parameters describe porous media: porosity and permeability. Porosity is "the ratio of pore volume to the total volume of a given sample of material", whereas permeability "is a measure of the ease with which fluids pass through a porous material" (Davis, 1969).

The porosity of unconsolidated deposits depends on their packing arrangements, size distribution and shape. The porosity of sand and gravel is 20 to 35 percent (Todd, 1959).

The intrinsic or specific permeability of a porous medium to a fluid is given by

$$k = \frac{Q\mu}{A\rho G}\left(\frac{dh}{dl}\right)^{-1} \qquad (1)$$

Where Q is the fluid volume discharged per unit time through a porous medium of cross-sectional area A, μ is the dynamic

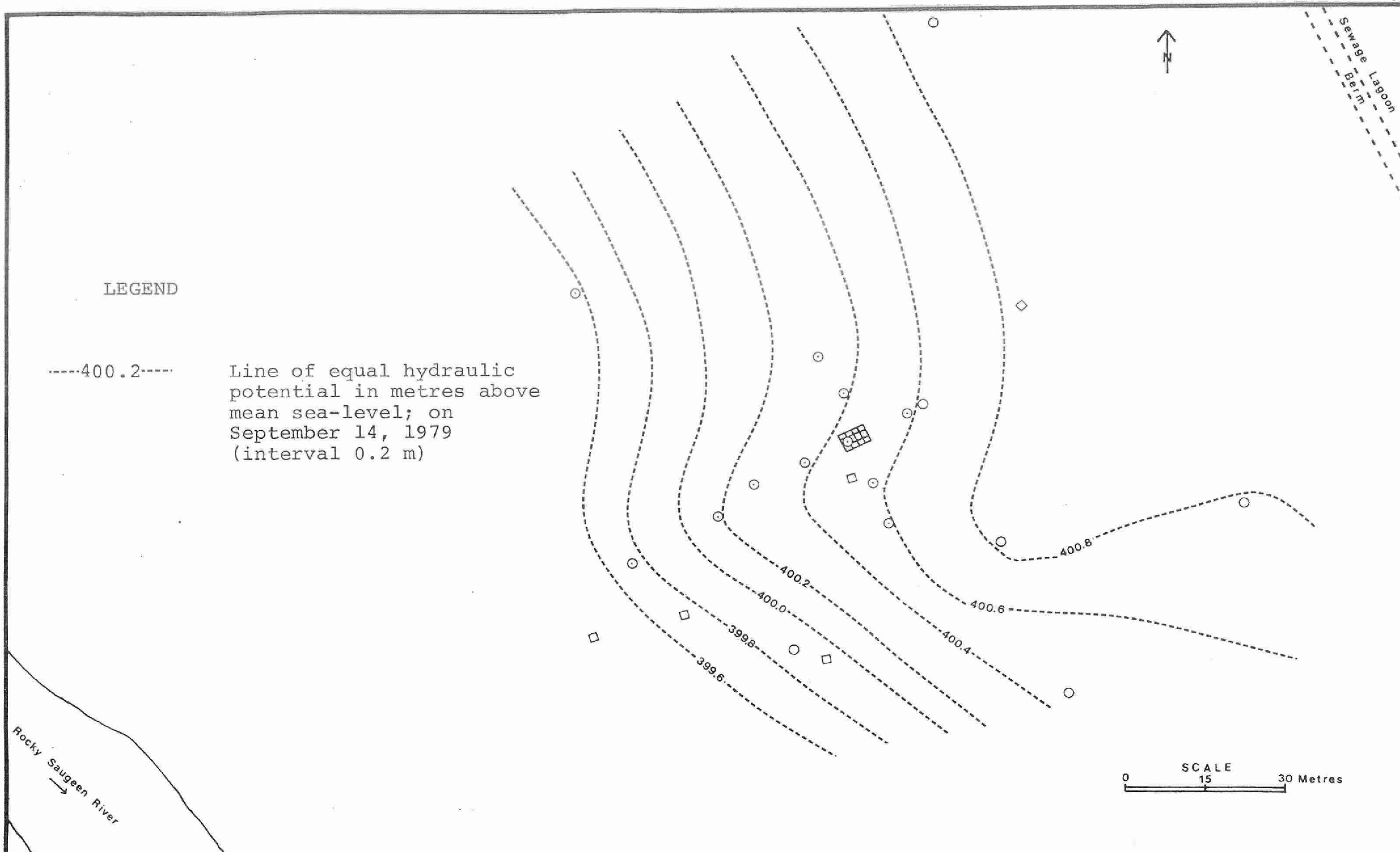


Figure 5. Potentiometric map of water table aquifer prior to rapid infiltration.

viscosity of the fluid, ρ is the fluid density, G is the accelaration due to gravity, and dh/dl is the hydraulic gradient in the direction of flow (Davis, 1969). The intrinsic permeability, k, has dimensions of L^2 and is a function of the geometric properties of the medium. Since hydrogeologists are mainly involved with water as the fluid, a more commonly used hydrogeologic variable is the hydraulic conductivity, K. If the terms in Equation (1) are rearranged the hydraulic conductivity may be defined as:

$$K = k\rho G/\mu \qquad (2)$$

which is often loosely referred to by hydrogeologists as the "permeability", i.e., the coefficient of permeability, and which has dimensions L/t.

Most analyses of groundwater flow in some way involve a principle known as Darcy's law, which has already been stated in one form in the definition of intrinsic permeability in Equation (1). It can be rewritten as:

$$q = -K\left(\frac{dh}{dl}\right) \qquad (3)$$

where q=Q/A in Equation (1) and is known as the Darcy or filter velocity, or the specific discharge, and K is the hydraulic conductivity in the l direction. The term q is not the average pore water velocity, but a seepage flux and has the units L^3/L^2t.

In this study a common method, the Hazen formula, was used to estimate the intergranular hydraulic conductivity of the sand and gravel deposits. This method is

Table 1. Selected values of the coefficient of permeability of surficial deposits determined by the Hazen formula

Location* source	Depth (m)	Coefficient of permeability K(cm/s)
TP-1	0.61	0.56
TP-1	1.22	0.11
TP-1	1.83	0.17
TP-2	0.61	0.42
TP-3	0.46	1.22×10^{-3}
TP-4	0.4	0.56
TP-4	0.73	0.40
TP-4	1.22	0.43

*Location is shown in Figure 2

based on the empirical equation developed by Hazen (1893). Although the relation has been refined in recent years, the Hazen formula

$$K\ (\mathrm{cm/s}) = C(d_{10})^2 \qquad (4)$$

essentially relates the hydraulic conductivity, K, to the effective grain-size diameter, d_{10}, by means of the coefficient C (which varies from about 50 $cm^{-1}s^{-1}$ to 150 $cm^{-1}s^{-1}$). The hydraulic conductivity is then proportional to the effective grain size of the deposit and is also a function of the degree of uniformity of the particle size. Since, as a rule, the Hazen formula gives higher values of permeability for clean gravel and sand deposits, the empirical coefficient C = 100 was used in this calculation.

The grain size distribution of the particles comprising surficial deposits in the study area is given in Appendix B. These data were used to calculate the coefficient of permeability applying the Hazen formula. The results are given in Table 1. It can be seen from Table 1 that values for hydraulic conductivity are relatively high.

Water Use in the Area

The water wells for which records are on file with this Ministry are indicated in Figure 1 (inset map). A summary of the water well records for these wells is given in Appendix D. Information from water well records indicates that the confined bedrock aquifer system is a source of water for these wells.

There are two municipal wells which supply water to the Village of Markdale and they are the nearest wells to the study area (about 1070 m distance). Information from water well records for these two wells indicate that water was encountered at several depths in the bedrock in both municipal wells (Figure 3). The pumping water levels in both wells appear to have reached dynamic hydraulic equilibrium condition with the lowest pumping water level at depths of about 27 m in both municipal wells. Water level recovery is rapid after the well production is stopped, indicating high capacities of both wells.

Since the municipal wells are located at relatively short distances from the rapid infiltration area, assurances should be made that water quality in these two wells and in the bedrock in general, remains unaffected. The likelihood that contamination of municipal wells would occur is unlikely because:

1. The thickness of surficial deposits (saturated zone) overlaying the bedrock is substantial.

2. There is a well defined hydraulic gradient in the shallow aquifer towards the river with prevailing lateral groundwater movement and the river is the ultimate groundwater discharge zone.

3. There is an upward gradient in the bedrock aquifer constituting the discharge zone of groundwater flow in the bedrock.

Nevertheless, several boreholes should be drilled in the study area and completed in the bedrock in order to check findings obtained using geophysical techniques. These bedrock wells may be used in the future to monitor water quality in the bedrock aquifer.

INFILTRATION STUDIES

Procedure

Sewage lagoon effluent was directly pumped into the infiltration basin by a gasoline-powered pump. The pumping equipment was placed on the lagoon berm, on the concrete top of the control manhole, whereas the pump intake was set into the sewage outfall chamber (Photo 7). The speed of the pump was throttled to keep constant head in the infiltration basin. Because of its tendency to fail, the pump needed close attendance; therefore, whenever the pump was running, its performance was frequently checked, generally between 6:00 and 23:00 hours.

Using a stop watch, an instant flow rate was obtained by reading the quantity of flow from the flowmeter (usually recording time for flow of 100 gallons). The stop watch and a calibrated container were also frequently used to check the reliability of the flowmeter which also gave a cumulative flow measurement.

The flow rate measurements, hydraulic head of the effluent in the recharge basin (staff gauge), and groundwater level in the observation well 1 (OW-1) were considered the bench-mark parameters of the study (Photo 8). They were, therefore, the subject of watchful attendance and measurements. For example, the only time period when the pump and basin area were not closely attended was between 23:00 and 5:00 hours the following morning.

Water levels were frequently measured in the observation wells and the open test pits. Numerous water samples from groundwater and surface water sources and of sewage lagoon effluent were collected for qualitative analyses.

Photo 7. Continuous pumping (intake in the control manhole) was provided by a gasoline-driven pump. A full drum provided about 12 hours of continuous run. Infiltration basin is located in front of coniferous trees at extreme left.

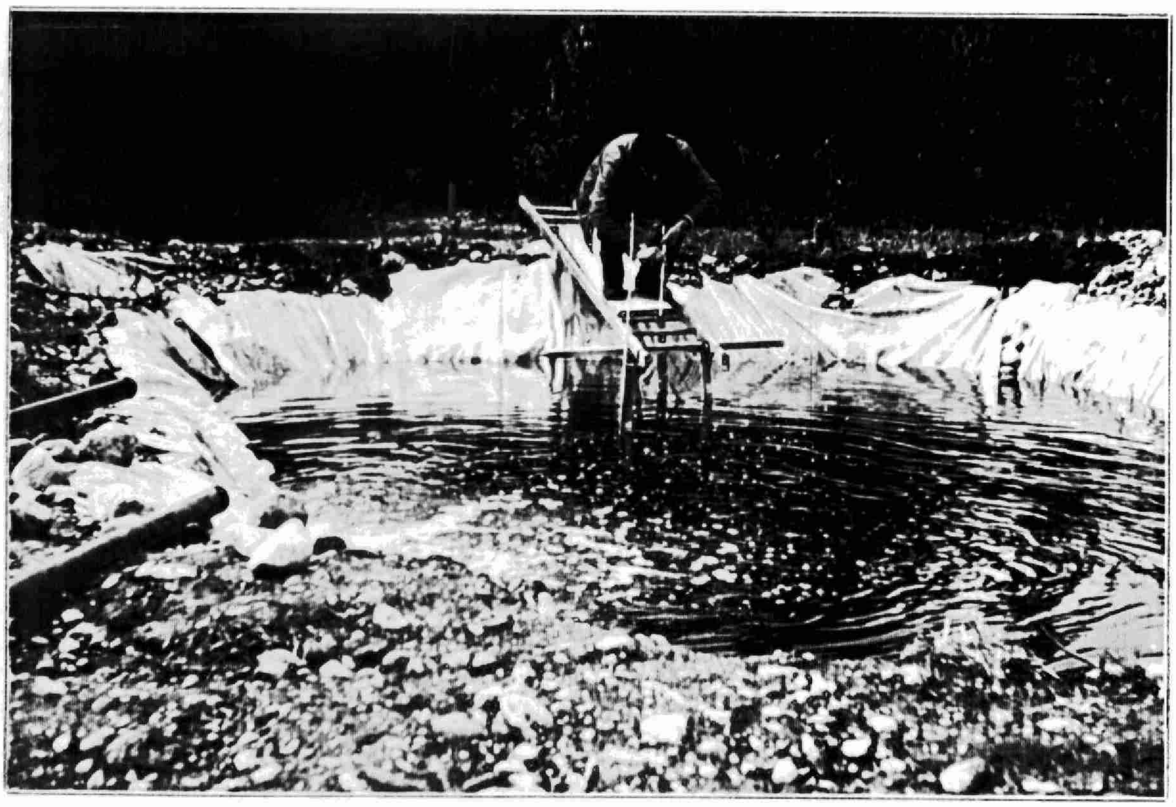


Photo 8. Recharge basin looking southwest. Inflow of 3.8 L/s. Water level is being measured in OW-1.

Table 2. Data pertaining to the recharge basin conditions and infiltration rates.[a]

Basin condition		Time period	Area of infiltration in basin		Average rate of infiltration	
Lining	Hydraulic head (m)		Contact	Area (m^2)	$L/s/m^2$	$m^3/d/m^2$
Lined on sides	0.61	Oct. 19, 1979 to Nov. 22, 1979	Bottom	12	0.28	24.19
No lining	0.4	Nov. 22, 1979 to Nov. 26, 1979	Bottom	12	0.24	20.74
			Sides	4.4	0.26	22.46

[a] This table should be read in conjunction with data shown in Figure 6.

Infiltration Rates

A continuous controlled infiltration study commenced on October 19, 1979 and continued with some dry up (resting) periods until November 26, 1979. Some of these stoppages were purposely planned, while a few of them were caused by failure of the pumping equipment.

In actuality, there were only 27 days of infiltration during which period about 8,020 m^3 of wastewater were infiltrated. This value was obtained from the spot measurements using a stop watch and a calibrated container for the initial six days of infiltration (before the flowmeter was installed) and from the accumulative values as recorded by the flowmeter for the remainder of the study period. Although not very reliable, an evaluation of the flowmeter performance showed that its resulting flow data should be increased by at least five percent. This correction of flow has been included in the above calculation.

Instantaneous flow measurements using both stop watch and flowmeter on one hand, and a calibrated container and stop watch on the other are plotted in Figure 6. It is apparent that flow values reported by the later technique are considerably higher than the conservative values recorded by the flowmeter and used in the above and the following calculations. Thus, when the infiltration reported by the flowmeter is adjusted to the flow values obtained by stop watch and calibrated container, close to 9,000 m^3 (2 MIG) were infiltrated to the granular deposits.

The results of the infiltration rates under different conditions in the infiltration basin are summarized in Table 2. It is apparent that they are relatively high infiltration rates.

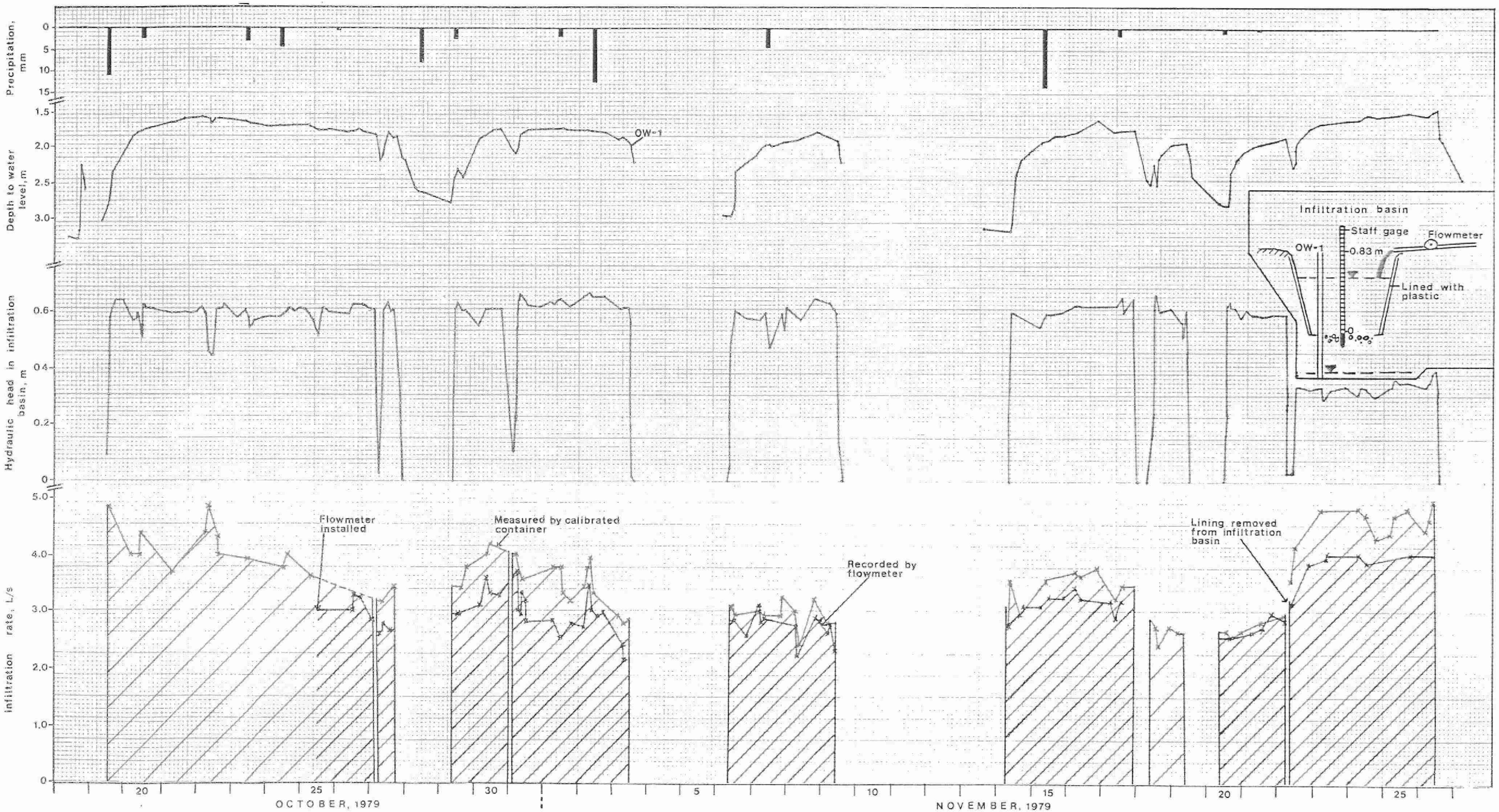


Figure 6. Infiltration rates, hydraulic head in basin, depth to water level in OW-1 and rainfall at site.

As indicated earlier, the sides of the infiltration basin were lined for the most part of this study. However, the lining was removed on November 22, 1979, four days before the termination of the recharge study. It should be noted therefore, that in calculating the infiltration rate for the lower portion in Table 2, it was assumed that the infiltration rates through the bottom of the basin remained constant at 2.88 L/s, as it was immediately before the lining was removed.

Heights of effluent in the recharge basin were fairly constant at 0.6 m, except for the last four days of the study. During this later period, the weakening of the pumping equipment, in concert with rapidly high infiltration rates, generated a relatively low hydraulic head in the basin (0.4 m).

The cumulative infiltration rates were plotted in Figure 7.

Hydraulic Response of the Shallow Water Table Aquifer to the Recharge

There were over 20 measuring points of the water table situated close to the infiltration basin. Although, there was no true piezometer nest with intakes placed at various depths, the obtained information from the available installations provides reliable data for an assessment of the hydraulic characteristics of the sand and gravel aquifer system.

The original static water level was at a depth of 3.5 m below ground level at the recharge basin, before the start of the infiltration program. The response of the

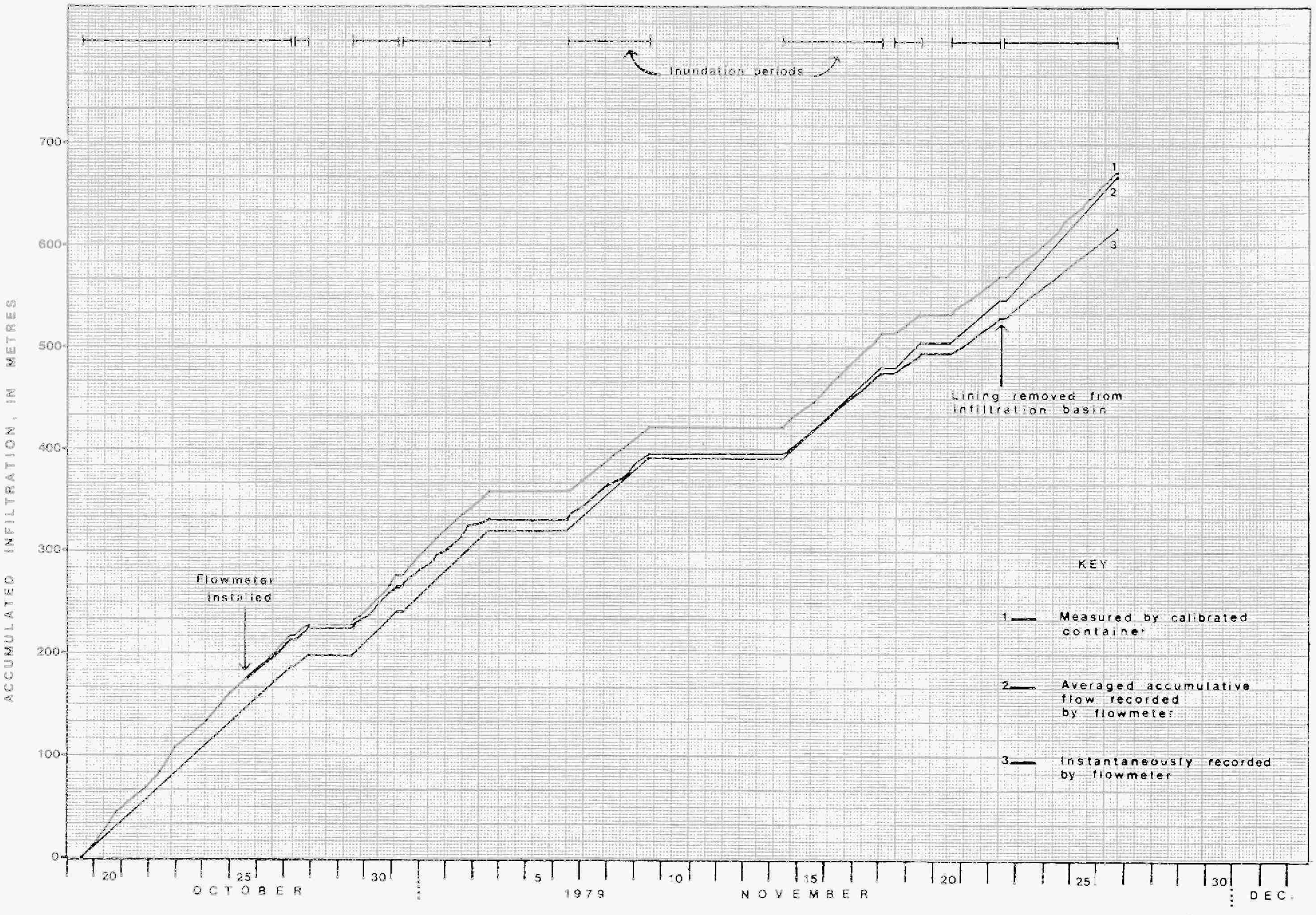


FIGURE 7. Cumulative infiltration of the lagoon effluent.

water table to infiltration was rapid, reaching an apparent hydraulic equilibrium underneath the recharge basin two days after infiltration commenced (Figure 6). In general, depths to water level below the basin remained relatively consistent at 1.7 m during infiltration periods. During the dry up periods the water level dropped rapidly to about 3 m and then the rate of recession slowed down considerably.

A similar situation prevailed in other observation wells and test pits located at various distances from the infiltration basin (Figure 8). It can be seen from this figure that the water table response was relatively rapid depending upon the distance of the observation point from the recharge basin. In general, a steady state condition in the affected wells was reached two to three days after infiltration began. It generally remained constant with periods of quick recessions during dry-up periods. One exception to this general pattern of water level behaviour occurred during the last four days of infiltration when the rate of recharge was the highest therefore causing the water level to reach its peak (Figure 8).

Sudden occasional drops in water levels in several observation wells, as shown in Figure 8, are caused by taking water samples from observation wells for qualitative analyses. Slow water level recovery was most likely caused by silting of the slotted section of the pipe which prevented water from moving quickly into the pipe.

The lateral distribution of the influence of infiltration on the water table is shown in Figures 9 and 10. The comparison of Figure 5 with Figure 9 shows how the well-defined groundwater flow (Figure 5) is modified by recharge (Figure 9), resulting in the formation of the groundwater hydraulic mound. The irregular shape of the hydraulic mound closely reflects the topographic gradient. There was no apparent indication of hydraulic channelling, or short circuiting.

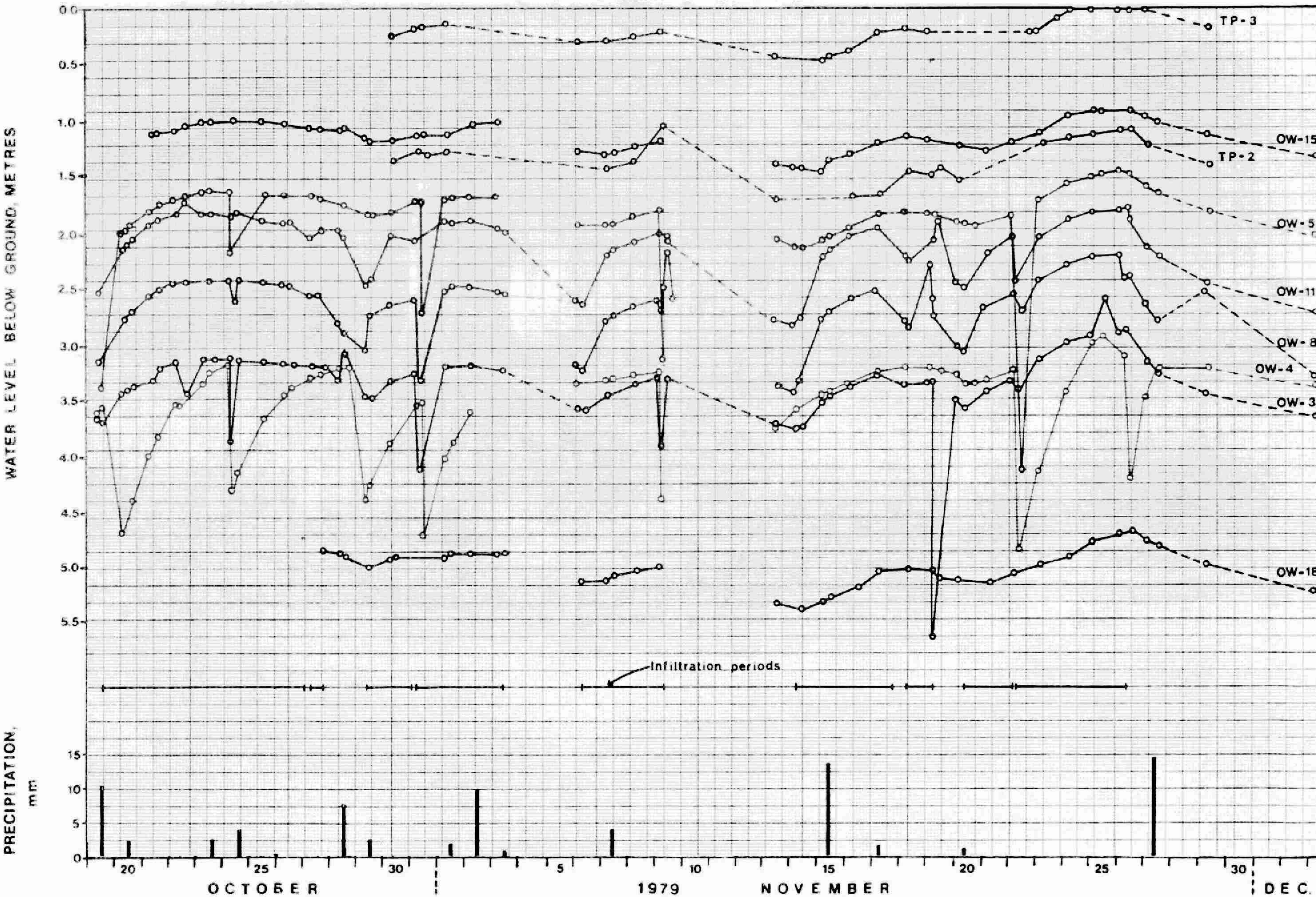


Figure 8. Response of water level to infiltration in observation wells and in test pits.

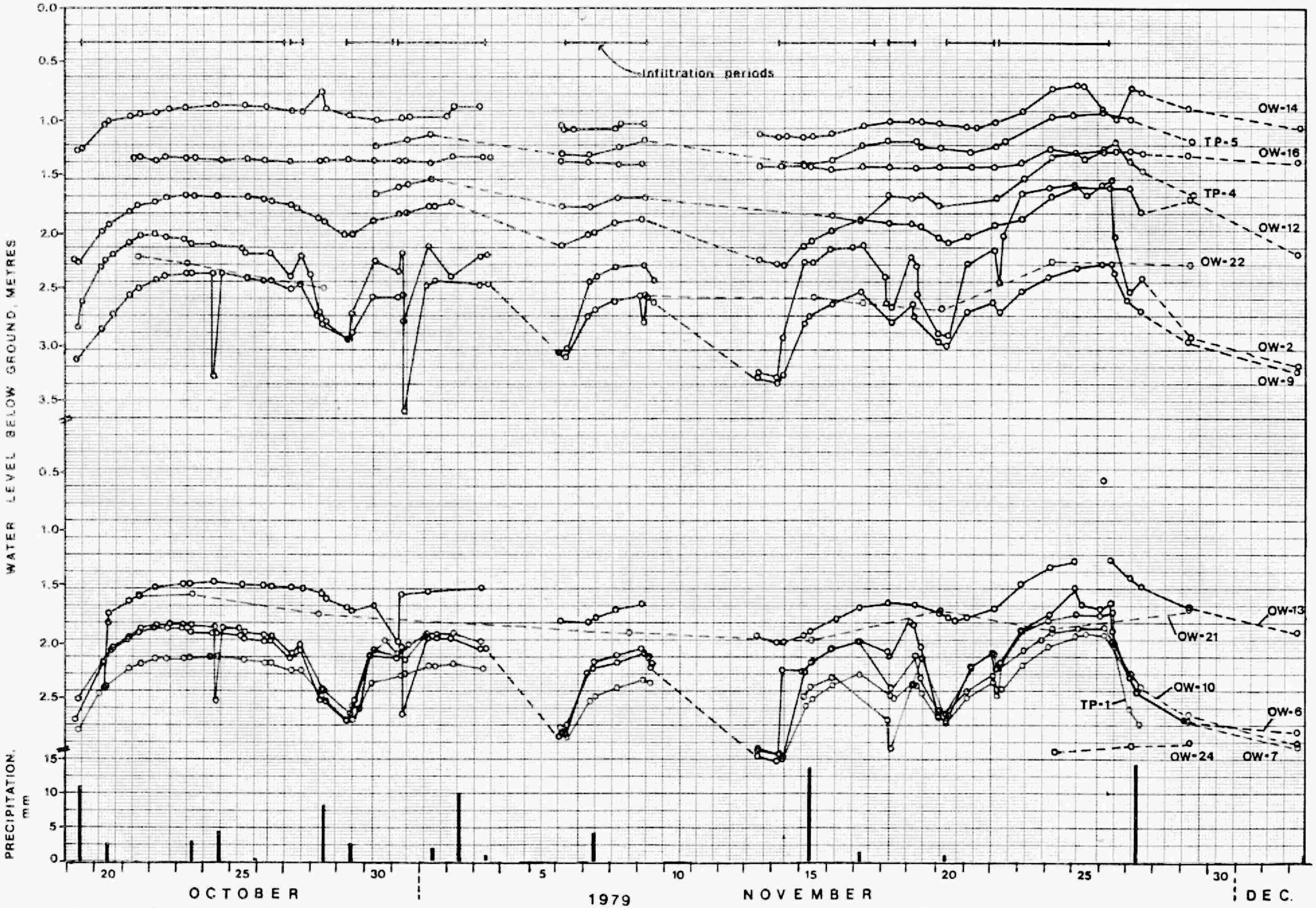


Figure 8 (Cont'd). Response of water level to infiltration in observation wells and in test pits.

An isopach of the groundwater mound is shown in Figure 10. Although the water level below the infiltration basin rose quite close to the bottom of the basin (0.6 m) it never actually reached it.

An apparent effect of groundwater mounding was a lateral shift of the highest margin of the groundwater discharge zone for about 30 m. This situation is illustrated in Figure 4.

Underground Detention Times

One of many important aspects of a rapid infiltration study such as this is to establish how long it will take for the effluent to reach the groundwater discharge area. This is because renovation of wastewater, which is influenced by several major factors, is directly related to the underground travelling time of infiltrated effluent. Detention times could be calculated in several ways such as by observing arrival of the pollution front, monitoring water level response, measuring the hydraulic gradient along the flow lines, dye test, etc.

The underground detention time is inversely proportional to the infiltration rate and to the permeability of the coarse granular material.

In this study, an attempt was made to use a direct method to calculate the permeability of granular materials. On November 20, 1979 after letting the basin dry up, 170 gm of fluorescein dye along with 213 litres of artificially made brine were placed at the bottom of the basin. The brine solution was made by dissolving 28 kg of uniodized salt using lagoon effluent as dissolvent. The concentration of the brine was as follows:

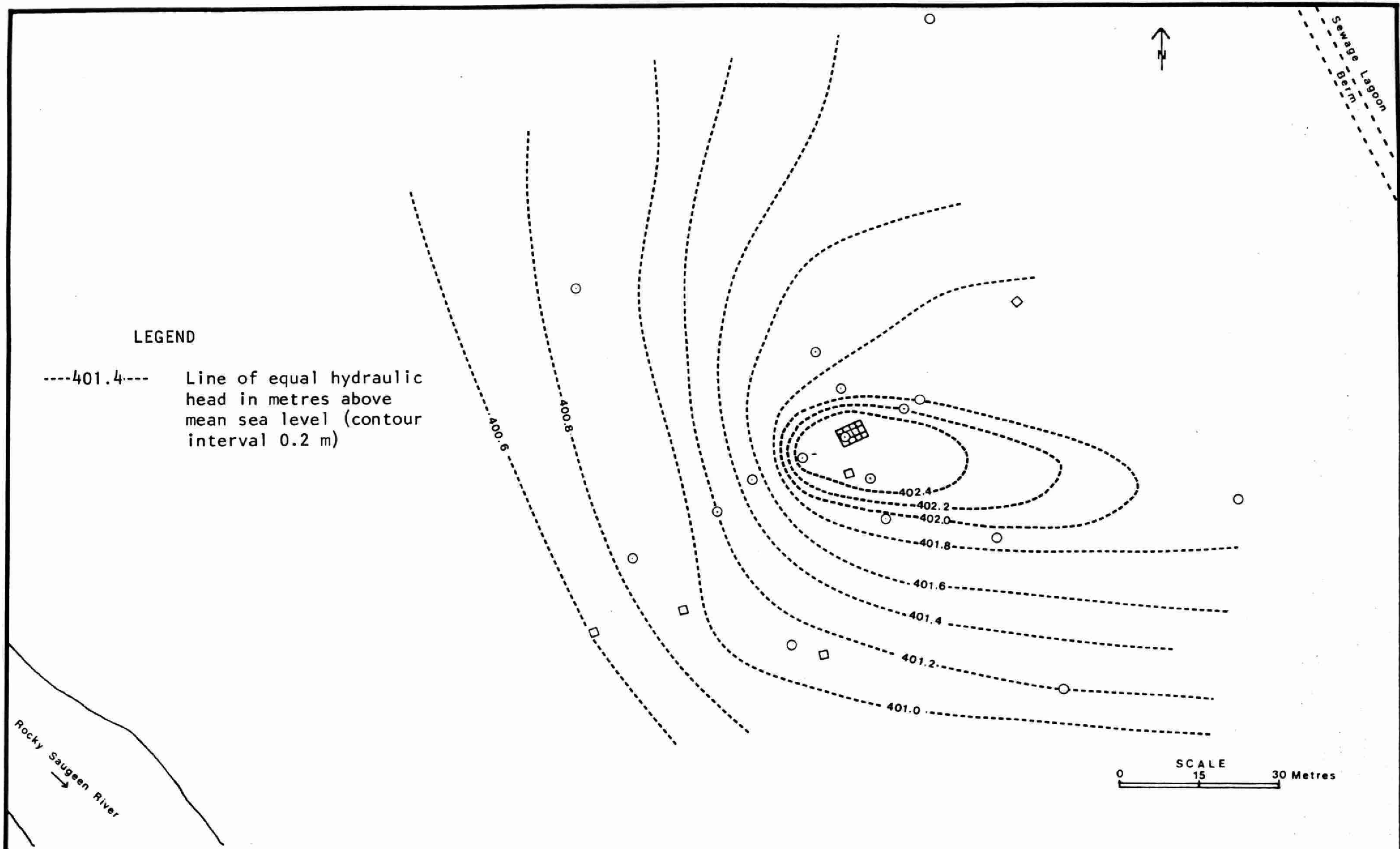


Figure 9. Distribution of hydraulic head in the water table aquifer at maximum groundwater mounding (Nov. 26, 1979).

Chemical parameter	Concentration
Conductance (umho/cm³ at 25°C)	153,615
Sodium as Na (mg/L)	48,179
Chloride as Cl (mg/L)	73,307

At the designated time the infiltration began, followed by frequent measurements of water levels, conductance and taking water samples from observation wells and test pits for fluorescein dye analyses.

Measurements of the specific conductance in observation wells was not successful in indicating the arrival of the contamination front (sodium chloride) nor was the fluorescein dye present in detectable concentrations in several monitored observation wells, and in TP-2, TP-3 or TP-4. It is reasoned that sodium chloride was quickly diluted in the rapidly infiltrating effluent, while the fluorescein dye was absorbed by silt and clayey particles. Nevertheless, closely monitored response of the water table in several observation wells and test pits gave valuable information on the hydraulic conductivity of the granular deposits.

The calculated values of the coefficient of permeability using the information from the mechanical analyses and the empirical formula presented by Hazen (1893) are given in Table 1.

The following equation was used to calculate the average linear pore-water velocity, V_x,

$$V_x = \frac{K}{n \vartheta_N} \text{ grad } h \qquad (5)$$

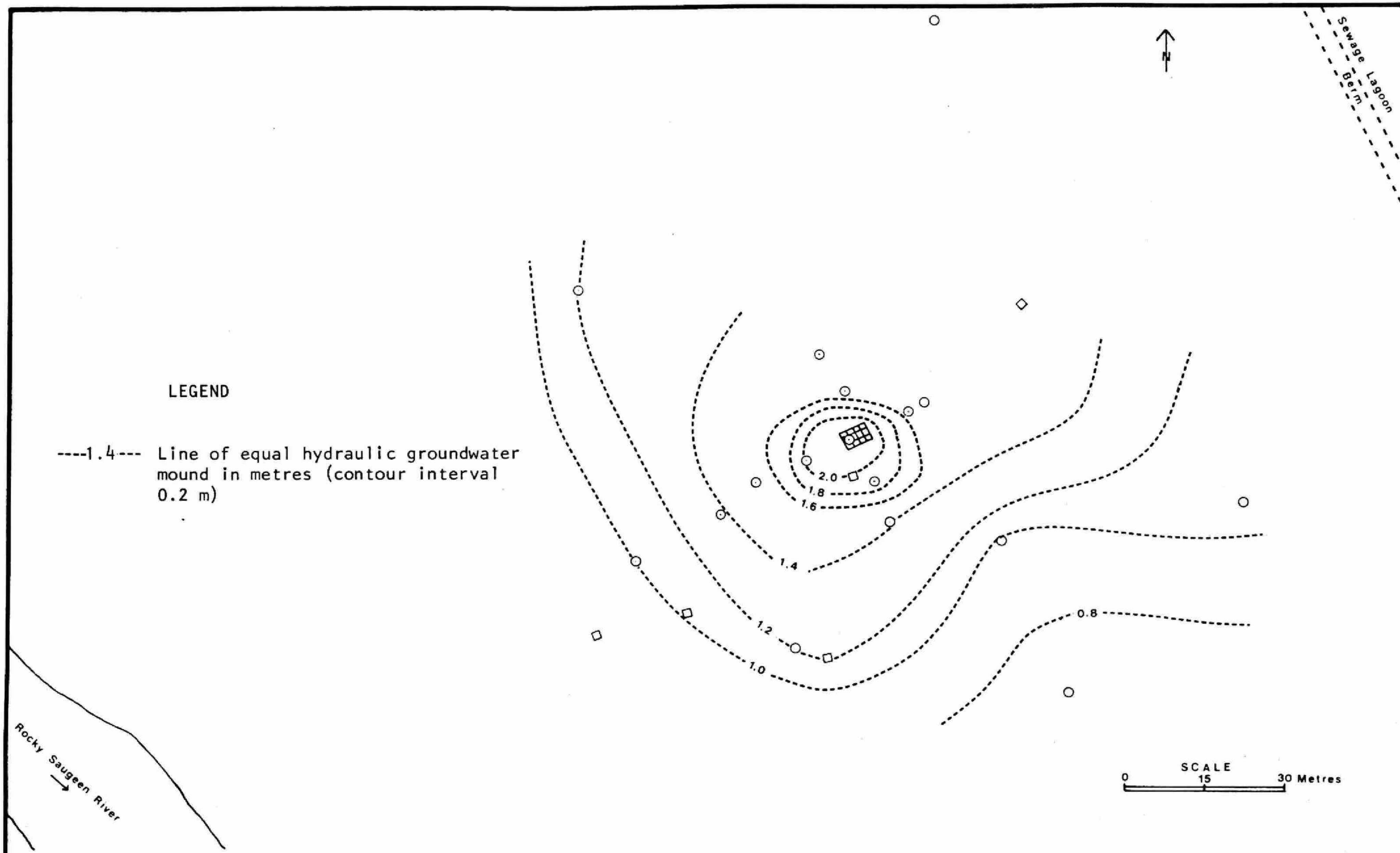


Figure 10. Isopach of maximum hydraulic groundwater mound (Nov. 25, 1979).

where K is hydraulic conductivity, n is the porosity, δ_N is an empirical constant and grad h is the gradient of hydraulic head. Experimental data on relatively uniform sands indicate that δ_N is close to 1 for these materials. It was assumed that the sand and gravel deposits have an intergranular porosity of 0.30 and the empirical coefficient was unity. Grad h for the original water table was 0.017, whereas during the groundwater mounding effect it was 0.032. As data on Table 1 indicate, the hydraulic conductivity varies somewhat; however, an average of seven values for the hydraulic conductivity was used (0.4 cm/s). Using these values the obtained average groundwater velocities were 20 m/d for the conditions prior to the commencement of infiltration and about 38 m/d during the groundwater mounding effect due to artificial recharge.

Based on the obtained data, it is estimated that the underground detention time was in the range of one and a half to three days. Since the original upper limit of groundwater discharge is located about 60 to 70 m from the river, there will be additional time for the effluent to travel overland through wet land before entering the river system. While travelling overland through favourable attenuating environments, it will be subject to a significant additional attenuation of certain parameters involving numerous processes present along the travelling paths.

Basin Clogging

Maintaining a high infiltration rate for long periods of time is essential for successful sewage lagoon effluent treatment by rapid infiltration. Understanding soil clogging processes that causes infiltration rate reduction is necessary for the design and long term operation

of the recharge system. There are three basic factors that can cause soil clogging; chemical, biological and physical.

Chemical clogging is largely caused by chemical interaction between chemical constituents dissolved in the effluent and present in the soil resulting in decreased pore diameter and consequently, lower permeability. Research shows that chemical clogging seldom occurs unless the sodium content of the effluent is high.

Biological clogging occurs when bacterial growth or its by-products reduce the pore diameter. Biological clogging is frequently associated with anaerobic conditions and usually occurs at the soil surface, but it can also occur at different depths (McGauhey et al., 1967).

Physical clogging is the result of suspended solids in the effluent blocking the soil pores. Some particles may penetrate to a greater depth if the pore size is larger than the diameter of the suspended solids. A restricting layer is therefore built up by these suspended solids. The hydraulic properties of the clogged layer are best expressed in terms of the hydraulic resistance or impedance, which is defined as the thickness of the layer divided by its hydraulic conductivity. According to Bouwer (1972) the impedance can be calculated as the head loss through the layer divided by the infiltration rate.

The gradual reduction in infiltration rates, as indicated in Figure 6 was caused primarily by physical clogging of the bottom of the infiltration basin (Photos 9 and 10). The examination of Figure 6 indicates that during the first inundation period, an initial infiltration rate of about 4.55 L/s was reduced to 3.4 L/s just before the pump was shut off eight and a half days later. A dry up period which followed, along with 8 mm of rainfall helped to somewhat restore the recharge rate to 3.78 L/s.

The infiltration rate at the end of the inundation period on November 9, 1979 was considerably low at 2.8 L/s. During the subsequent resting period, the longest in this study which lasted about five days, the subzero temperatures caused several inches of the basin to freeze. Consequently, the basin was thoroughly raked and harrowed with a pick before the next inundation period started. This action resulted in restoring the recharge rate to 3.5 L/s.

During the short dry up period on November 19 and 20, 1979 the basin was thoroughly raked again. This action had no effect on restoring the infiltration rate, probably because the weather during the resting period was wet and too short to have an effective improvement on the accumulated sludge at the bottom of the basin. Also, fluorescein dye and artificial brine, which were introduced in the basin just before the start of the flooding period, may have some negative effect on improving the recharge rate.

An obvious indication that physical clogging occurred affecting about 5 cm in depth of the bottom of the infiltration basin (Photo 10) is demonstrated by the data shown in Table 2. After the plastic liner was removed from the sides of the infiltration basin, the infiltration rate through the "fresh" sides of the basin was higher than through the basin's bottom, although the former area was 2.72 times smaller than the latter infiltration area.

During the initiation and termination of the infiltration stages the arrival of the initial flux of the effluent was carefully measured in OW-1. Likewise, "drawdown" of the effluent in the basin when the pump was shut off was also recorded at designated time intervals.

Using this information the increase of impedance was calculated. Since the restricting layer was not com-

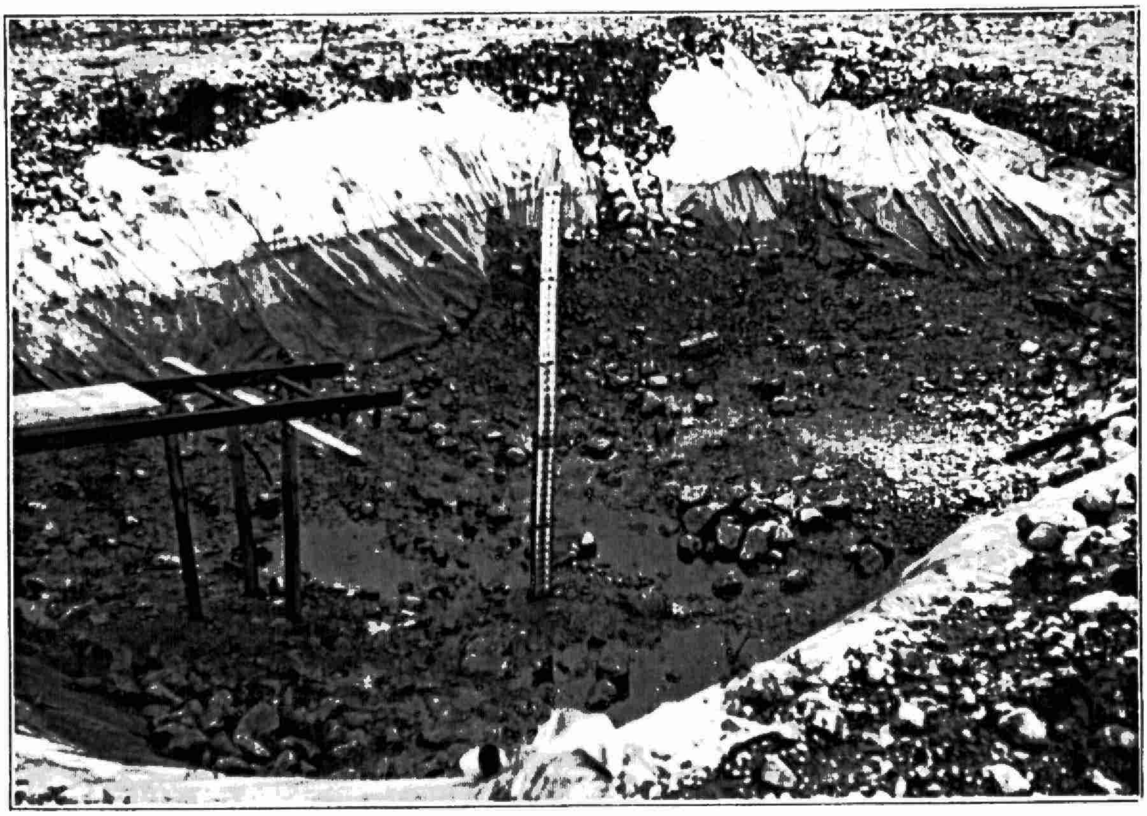


Photo 9. Deposition of suspended solids after 8 days of continuous infiltration indicates gradual basin clogging.

Photo 10. A thin crust at basin bottom began to develop at the end of the first inundation period. This basin clogging appears to have significantly affected very shallow depth.

pacted and biological clogging is unlikely a factor, the resistance should increase in proportion to the suspended solids added. The suspended solids in the lagoon effluent are mostly organic and easily compacted. They also tend to develop more rapidly in the lower sections of the infiltration basin (Photo 9).

WATER QUALITY STUDIES

General

In this section, a brief discussion of the water quality of the aquifer system which received the lagoon effluent as well as quality of surface water is given. The results of the qualitative analyses of water and the sewage lagoon effluent are given in Appendices E through J inclusive. These analyses can be used by individuals interested in further pursuing the qualitative aspect of this study.

Procedure

Numerous grab samples were obtained from the observation wells, test pits and from the selected surface water sampling stations. Several samples of the lagoon effluent were obtained directly from the infiltration basin and analysed for generally the same qualitative parameters. The frequency of sampling is summarized in Table 3.

A bailer 2.54 cm in diameter was used to obtain water samples from observation wells, whereas, a grab sample was taken from the test pits. The bailer was washed out with distilled water following each sampling. While the bottom of test pits 1, 2 and 4 are normally in the unsaturated zone, the rise of the water table due to infiltration provided favourable conditions to obtain water samples from these test pits as well.

Table 3. Frequency of sampling during the rapid infiltration study.

Date	Sept.				October, 1979								November, 1979								Jan. 1980
Sampling Point[a]	12	18	19	22	23	24	27	28	29	31	3	6	9	12	16	20	22	23	25	26	31
OW-1	c	bm ccc	cc		c	c		b cm		c	ca		c	c	c	b	cc ca		c	bm	bm
OW-2	c	bm cc	c			c		b bm		c	a		c			b	ca		c	bm	bc
OW-3	c	cmb				c		cm		c	a		c			b	ca		c	m	bc
OW-4	c	b	c			c		cm		c	a		c	c		b	ca		c	m	bc
OW-5	c	bm	c			c		cm		c	a		c	c		b	ca		c	m	ba
OW-6	c	ccm	c			c				c	a		c		c	b	aa ccc		c	m	bc
OW-7	c	cm				c				c	a		c		c	b	ca		c	m	bc
OW-8	c	ccm	c			c				c	a		c			b				m	bc
OW-9	c	m	c			c				c	a		c			b	ca			m	bc
OW-10	c	ccm	cc			c				c	a		c			b	ca			m	bc
OW-11											a					b					
OW-12	c										a					b					bc
OW-13															c	b			c		bc
OW-14	c										a					b			c		bc
OW-15	c										a					b			c		b
OW-16											a					b			c		bc
OW-18										cm	a		c			b	ca			m	bc
OW-21					c																
OW-22					c								c								
TP-1										cc mm	c		cc				ca		c	bm	
TP-2										cm	a		c			b	ca		c	bm	
TP-3										cm	a		c		c	b	ca		c	bm	bc
TP-4										cm	a		c			b	ca		c	bm	
TP-5										cm	a		c		c	b	ca		c	bm	
RSR-1				bc			cm		c		a		c			b	ca			m	bc
RSR-2												cm	c			b	ca				
RSR-3												cm	c			b	ca				
RSR-4				bc			cm		c		a		c			b	ca			m ccm	bc
P-5							cm				a					b	c	a			bc
P-6							cm														
Lag. eff.		cm	c								c				c		b	ca	c	bm	bc

[a] Location of sampling points is shown in Figures 1 or 2.
OW - Observation well; TP - Test pit; RSR - Rocky Saugeen River; P - Pond water

Symbols: c - Chemical analysis
m - Heavy metals analysis
a - Anionic detergent analysis
b - Bacteriological analysis

Because there was a considerable amount of silt in water samples bailed from the well, for the purpose of uniform sample treatment, all groundwater samples were filtered except for the initial few sets, and for all samples taken for phenolic compounds and for carbons. The samples were filtered through a glass fiber filter paper with two micron openings.

In order to assess the effects of well bailing prior to taking water samples and filtering several sets of water samples from OW-1 and OW-6 were obtained and analyzed subsequent to various conditions. The results are shown in Table 4. It is apparent from this table that the differences between the chemical analyses of water samples taken from observation wells prior and after bailing were insignificant.

Quality of the Lagoon Effluent

During the inundation periods of the infiltration basin, several samples of the lagoon effluent were collected directly from the infiltration basin for qualitative analyses. A few of these samples were filtered so that they would be comparable with groundwater samples. However, the majority of effluent samples were not filtered prior to analyses.

The results of the qualitative analyses of the sewage lagoon effluent is given in Appendices G and J respectively.

The mean values of the results for four unfiltered chemical analyses of the sewage lagoon effluent were calculated and shown in Table 5. The loading by various chemical parameters from the conservative calculation of the total infiltrated lagoon effluent was calculated and also shown in Table 5.

Table 4. Results of chemical analyses of water samples obtained and analysed under various conditions.[a]

Sampling Point	Observation Well 1 (OW-1)			Observation Well 6 (OW-6)		
	Before bailing		After bailing	Before bailing		After bailing
Constituent[b]	Non-filtered	filtered	filtered	Non-filtered	filtered	filtered
Hardness (calc.)	270	255	258	329	278	275
Alkalinity as $CaCO_3$	269	262	264	273	273	275
Iron as Fe	8.4	0.20	1.32	38	0.30	0.60
pH	7.50	7.88	7.69	7.45	7.99	7.70
Conductance - umho/cm³ at 25°C	755	755	760	778	780	799
Chloride as Cl	62.0	61.5	63.5	66.5	67.0	68.5
Sulphate as SO_4		36.5	36.5		34.5	37.5
Calcium as Ca	63.0	58.0	57.0	104	63.0	61.0
Magnesium as Mg	27.2	26.8	28.0	32.0	29.2	29.8
Sodium as Na	56.0	57.0	56.0	53.0	55.5	41.8
Potassium as K	7.25	7.65	7.75	6.00	4.75	1.95
Free ammonia as N	2.7	1.0	2.9	2.0	2.2	2.4
Total Kjeldahl as N	8.25	4.00	4.90	2.50	2.95	3.70
Nitrite as N	0.08	0.145	0.03	0.24	0.22	0.03
Nitrate as N	2.4	4.3	2.1	1.8	2.0	2.2
Total P. as P	3.10	2.05	2.00	0.70	0.053	0.08
Diss. react. P. as P	2.15	1.85	1.75	0.20	0.001	L0.05
Inorganic carbon		63.0	65.5		67.5	69.5
Organic carbon		19.0	27.0		16.5	18.0
Total carbon		82.0	92.5		84.0	87.5
Phenols in ppb			L1.0			L1.0

[a] sampled on November 22, 1979

[b] All results except pH reported in mg/L unless otherwise indicated.

L - Refers to less than

The concentrations of suspended solids were relatively low during the time of year in which the study was carried out.

Groundwater Quality

Basic Considerations

The existing hydrogeological conditions in the study area and the hypsometric position of the sewage lagoon may suggest that exfiltration of the lagoon effluent has occurred particularly during the initial stage of the lagoon operation. This aspect could be further advanced and utilized to the existing conditions with an attempt to assess the renovation (which occurred in the past) of the effluent by natural hydrogeological environment.

This study showed that there was no convincing evidence that the quality of the shallower zone of the water table aquifer from which most of the samples were obtained was affected by the leaks from the lagoon. Therefore, such approach will be speculative at this time. For example, groundwater quality from sampled wells and test pits located between the lagoon and the recharge basin showed no indication that water quality is affected by the nearby lagoon. However, few sampled observation wells which obtain water from a somewhat lower elevation and which are located between the recharge basin and the river showed occasionally variation in water quality that may have been influenced by an "outside" source. This aspect is discussed in the later sections of this report.

In any case, in this study groundwater quality obtained prior to the commencement of the lagoon effluent infiltration is considered as the existing "natural" back-

Table 5. Quality of the infiltrated sewage lagoon effluent and calculated loading by recharged sewage lagoon effluent.

Constituent	Average value of four analyses (unfiltered) (mg/L)	Calculated loading (kg)
Hardness (calc.)	258	2069
Alkalinity as CaCO3	292	2342
Iron as Fe	0.07	0.56
pH		7.65
Chloride as Cl	57.25	459
Sulphate as SO4	34.12	274
Calcium as Ca	57.12	458
Magnesium as Mg	27.95	224
Sodium as Na	55.37	444
Potassium as K	8.0	64
Free ammonia as N	5.66	45
Total Kjeldahl as N	10.6	85
Nitrite as N	0.43	3
Nitrate as N	0.19	1.5
Total P as P	3.06	25
Dissolved reactive P.	2.45	20
Inorganic carbon	66.62	534
Organic carbon	33.5	269
Total carbon	100.12	803
BOD5	20.05	161
COD	284	2277
Suspended solids	19.33	155
Phenols (ppb)	F1	

F refers to less than

groundwater quality. Any subsequent changes of groundwater quality during this study were related to the recharge and compared with the initial water quality. It is considered that this approach did not alter the validity of any groundwater quality interpretation.

It is generally accepted and confirmed in this study that the concentrations of the majority of chemical constituents in groundwater samples obtained during this study mainly depend on several factors such as (a) distance of the sampling point from the recharge basin, (b) duration of inundation of the recharge basin before sample was taken, (c) thickness of the unsaturated zone below the recharge basin, (d) lithological composition along the travelling path before the sampling point, etc.

The results of the chemical, heavy metals and bacteriological analyses of groundwater are given in Appendices E and H respectively.

Nitrogen Cycle

The total nitrogen content of the sewage lagoon effluent generally ranged between 10.5 and 13 mg/L. Almost all of the nitrogen in the effluent was in the form of free ammonia and total Kjeldahl nitrogen.

The areal distribution of the major components of the nitrogen cycle at the beginning and at the end of the study is shown in Figure 11. This map shows that almost all nitrogen has been either converted into nitrate or attenuated at a distance of less than 40 m from the recharge basin along the shallow groundwater path toward the Rocky Saugeen River. However, the concentrations of the components of the nitrogen cycle show irregularity along the main

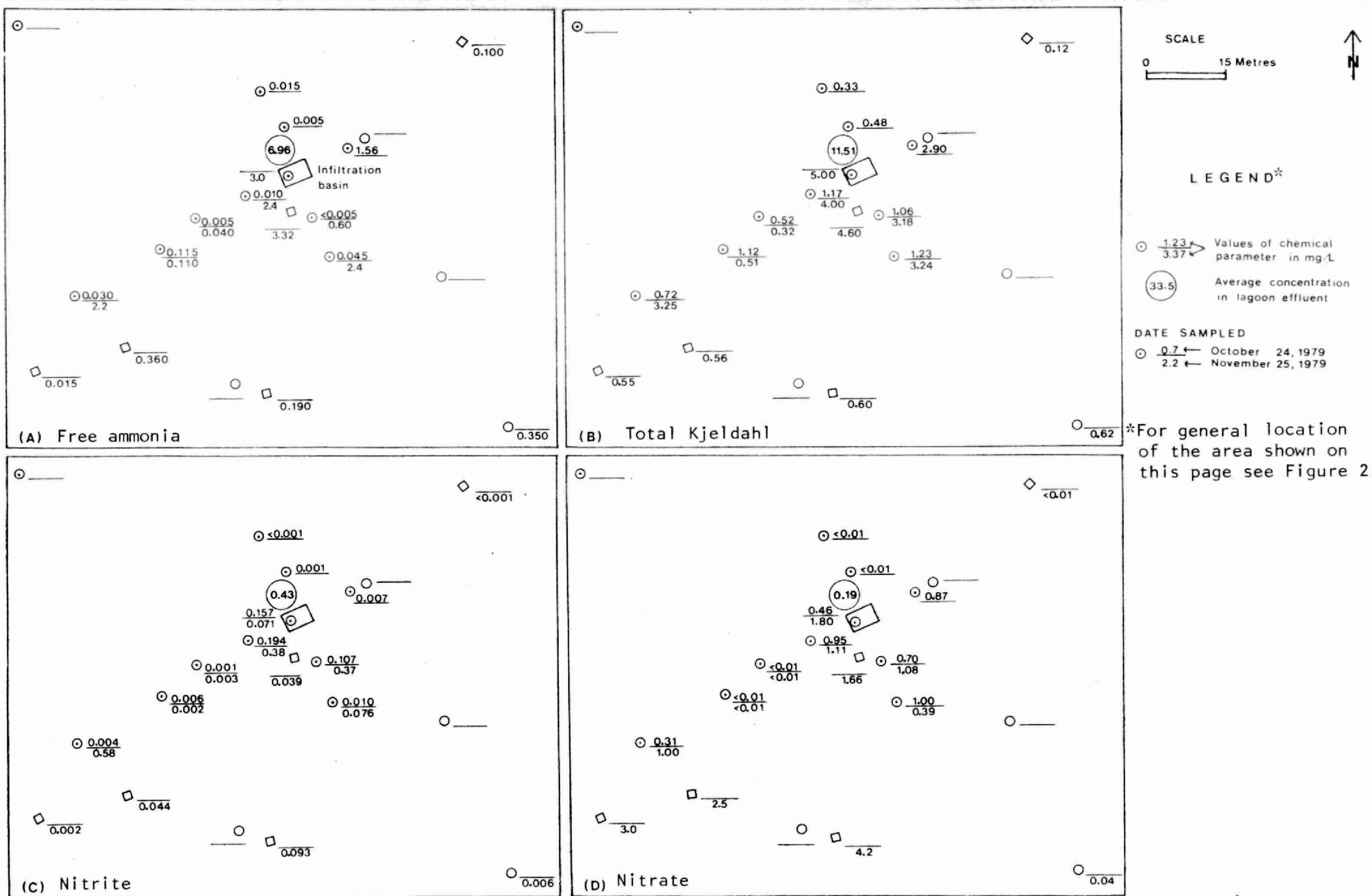


Figure 11. Hydrochemical map of free ammonia (A), total Kjeldahl (B), nitrite (C), and nitrate (D), concentrations in shallow groundwater

groundwater flow component at different distances from the basin. There are several factors that could contribute to this difference such as: (a) elevation of intake of the sampling station, (b) depth of intake below water table, (c) type of sampling point (observation well vs open test pit in which case nitrification may readily occur), (d) distance of the sampling station from the recharge basin, (e) the duration of basin flooding and quantity of effluent recharged before the sample was taken, (f) thickness of unsaturated zone (presence of oxygen), (g) travel time (time necessary for a population of nitrifying bacteria to develop), etc.

Nevertheless, the data indicate that almost all nitrogen which will be discharged to the ground surface some distance from the Rocky Saugeen River will be in the nitrate form. This nitrogen will be subject to further reduction by microbial processes thriving in the wet cattail environment along the river.

There are various processes which can remove nitrogen from waste water while it moves through soil, including adsorption of ammonium to the clay, silt and organic fraction of the soil, fixation of ammonium by the organic fraction, fixation of nitrogen by micro-organisms, and nitrogen uptake by vegetation. Volatalization of ammonia and denitrification are the only processes which cause a net removal of nitrogen. The other processes merely store nitrogen in the soil.

Research shows that the mechanism of nitrogen denitrification occurs when a new basin flooding is started. When inundation commences there is entrapped air in the soil for nitrification of ammonium during the initial part of the flooding period. However, as the oxygen is consumed, anaerobic conditions will begin to develop where nitrate and organic carbon can both be present, creating conditions

favourable for denitrification. With continued flooding all nitrogen will stay in the ammonium form, which can be adsorbed by the soil particles. If flooding is not stopped before the cation exchange complex in the soil is saturated with ammonium, increased ammonium levels in the receiving groundwater can be expected. When the flooding is stopped, air will enter the soil and the resulting aerobic conditions in the shallow unsaturated zone will enable nitrification of the adsorbed ammonium. Some of the nitrate formed in this process may diffuse to anaerobic microenvironments in the same soil and denitrification can occur if organic carbon is also present. Some of these nitrate ions may also mix later with the newly infiltrating water when a new flooding period is started and move down to anaerobic environments where denitrification may occur.

In conclusion, setting up proper inundation dry up periods is of great importance with respect to the denitrification processes and therefore nitrogen removal.

Phosphorous

The concentration of phosphorous in the lagoon effluent and the detrimental impact on water quality in the Rocky Saugeen River is one of the prime concerns with respect to the present mode of the sewage treatment system operation at Markdale.

Phosphorous removal seems to occur rapidly as the effluent water moves through the sand and gravel deposits (Figure 12). Although a slight increase of the dissolved reactive phosphorous is indicated (as the infiltration proceeded) at a distance of 10 m there is no doubt that favourable conditions do exist in the sand and gravel de-

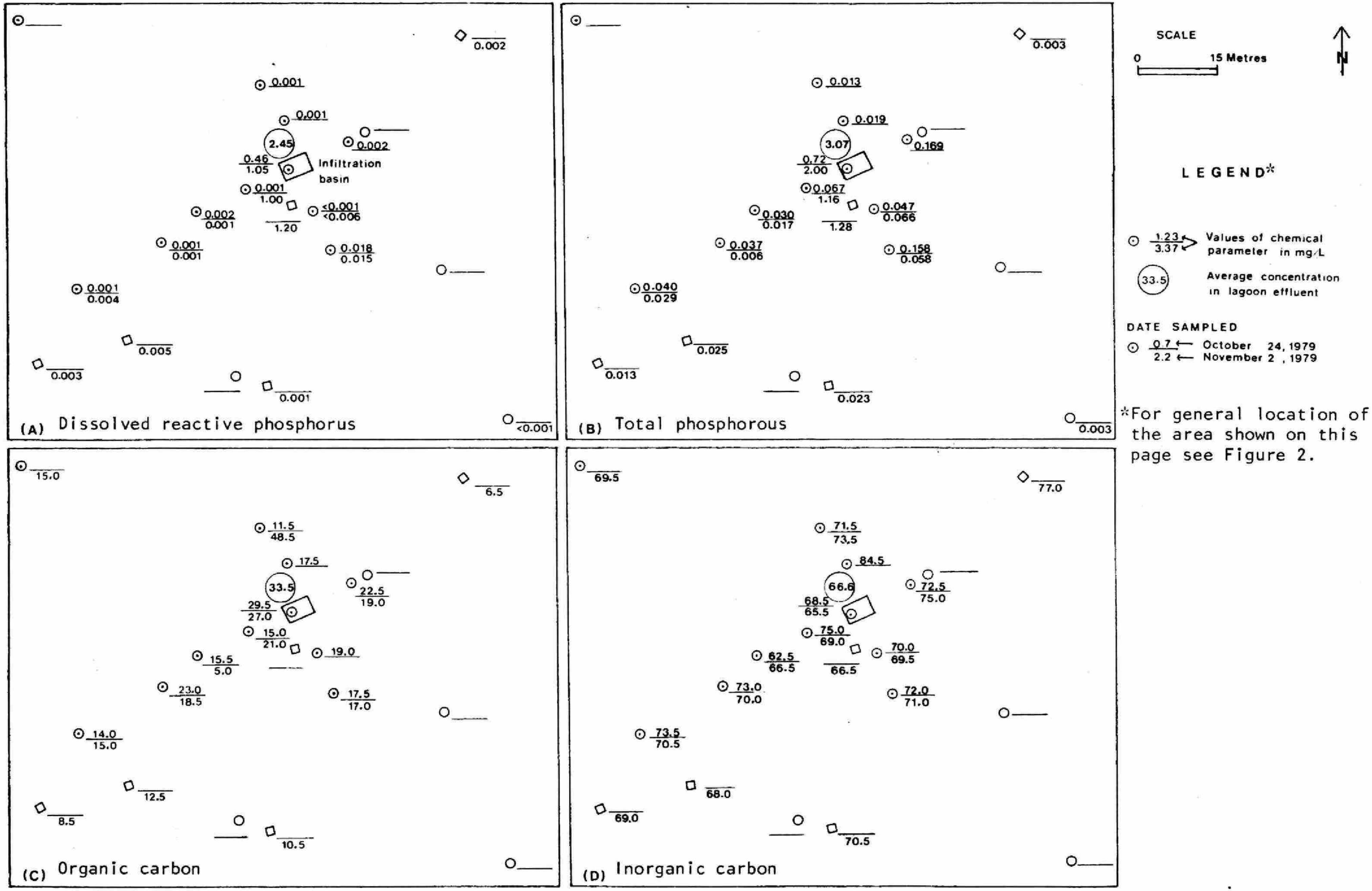


Figure 12. Hydrochemical map of dissolved reactive phosphorous (A), total phorphosour (B), organic carbon (C), and inorganic carbon (D), concentrations in shallow groundwater.

posits for the removal of phosphorous from the effluent. The presence of a calcium-rich environment and iron and aluminum oxides in the granular materials are the main contributing factors for the removal of phosphorous. It is considered, however, that the removal of phosphorous is probably due to precipitation of calcium-phosphate complexes, which are formed in the slightly alkaline and calcium-rich environment of the effluent water as it moves through slightly silty sand and gravel deposits.

Total removal of phosphorous is very encouraging since it is considered the main constituent to have an adverse effect on river water quality.

Phosphates are the only constituents of the effluent that precipitate in quantity in the soil. This precipitator may affect the porosity and hence the hydraulic conductivity of the sand and gravel in the long-term operation. However, considering the pore space of the sand and gravel deposits to be about 30 percent and relatively small amount of precipitate (oxy-apatite), it will probably be a very long time before phosphate accumulation in the sands and gravels will have a significant effect on the hydraulic performance of the system.

Carbons

The areal distribution of the organic and inorganic carbons is shown in Figure 12. It is indicative that at a distance of less than 40 m from the basin, the organic carbon is removed to the background concentrations.

Phenolic Compounds

Of six analyses of sewage lagoon effluent five showed concentrations of phenolic compounds to be less than 1 part per billion (ppb) and only one sample indicated that the phenols content was 25 ppb. However, this sample was taken in January, 1980, directly from the lagoon under ice conditions long after field work of this study was completed.

Contrary to the very low concentration of phenolic compounds in the lagoon effluent, several samples of groundwater showed considerably high concentrations of phenols. These include samples obtained from OW-4, OW-5, OW-8 and OW-9. The highest values of phenol concentrations in groundwater were in the samples collected on the day when the flooding of the basin started (October 19, 1979). This may suggest that these phenolic compounds are naturally occurring in the shallow groundwater. Another more likely explanation is that since two of these sampling points obtain water from a deeper elevation than other sampling stations their water quality is influenced by the deeper groundwater flow system whose quality may have been affected by exfiltration of the lagoon effluent. Increased concentration of phenolic compounds in the deeper sampling wells is in tune with the sporadic increased concentrations of few other chemical parameters in these wells. A third possibility is that the groundwater was slightly contaminated with phenols during the drilling of the observation wells.

Biochemical and Chemical Oxygen Demand

Since the majority of groundwater samples contained considerable amounts of silt and consequently were filtered, the results of biochemical (BOD_5) and chemical

oxygen demand (COD) were influenced by these factors. For this reason only few sets of initial samples were analysed for biochemical and chemical oxygen demand. Thus, waste-water renovation with respect to these constituents cannot be assessed.

The BOD_5 of the sewage lagoon effluent was relatively high and in the 20 to 30 mg/L range.

The COD of the lagoon effluent usually was in the 280 mg/L range.

Total Dissolved Solids and Major Ions

Total dissolved solids were calculated by measuring the specific conductance of water samples and multiplying it by a factor of 0.65.

The concentrations of total dissolved solids of the lagoon effluent were in the 400 to 515 mg/L range (Table 5) and concentrations in native groundwater were in the 400 to 470 mg/L range.

A brief discussion regarding the behaviour of the major ions in groundwater during the rapid infiltration study is given in the following paragraphs.

In general the concentrations of calcium fluctuated between 55 and 104 mg/L with maximum value found in OW-6 and the lowest value in TP-1. The concentrations of calcium in unaffected groundwater were between 70 and 80 mg/L.

Magnesium content in the native groundwater was around 30 mg/L but it may go as high as 70 mg/L. In renovated water the maximum concentration of magnesium was 62 mg/L (OW-4) while the minimum value was 23.6 mg/L (OW-1).

Concentrations of sodium in renovated water fluctuated between 67 mg/L (TP-1) and a minimum value of 3.8 mg/L (OW-4). The background concentration of sodium in groundwater was about 11 mg/L.

Background content of potassium in groundwater was about 0.7 mg/L. The maximum concentration of potassium in affected groundwater was reported at 9.8 mg/L (OW-1), whereas the minimum content was 0.7 mg/L (OW-10).

Chloride concentrations in renovated water fluctuated between a maximum value of 91 mg/L (OW-5) and a minimum concentration of 13.5 mg/L (OW-3). The background value of chloride in groundwater was about 20 mg/L.

The background concentration of sulphate in groundwater was around 10 mg/L. In renovated water the content of sulphate fluctuated between a maximum value of 61 mg/L (OW-4) and a minimum concentration of 4.0 mg/L in observation well 10.

pH

The pH of the lagoon effluent was usually between 7.69 and 8.01 and pH of the renovated water was between 7.35 and 8.0 mg/L. The pH of the native groundwater ranged from 7.5 to 7.7 mg/L.

Anionic Detergents

Anionic detergents are not found in natural conditions. Therefore, the presence of these substances in natural waters indicates contamination by domestic or industrial wastes.

Two sets of samples were obtained from most of the monitoring stations and analysed for anionic detergents (November 3 and November 21, 1979). The results of the November 3 set of samples indicated the concentration at or below the detection limit of 0.1 mg/L. The only exception to this, was OW-1 which had a concentration of 0.4 mg/L.

The results of the second set of samples showed a slight increase of anionic detergent concentrations in several observation wells and test pits. However, none of these observation points had values exceeding 0.4 mg/L.

The concentration of anionic detergent in the sewage lagoon effluent of only one sample was 0.1 mg/L.

Heavy Metals

It is indicative that non-filtered samples of groundwater have relatively high concentrations of heavy metals, in particular aluminum with concentrations of several hundred milligrams per litre, then manganese and zinc not exceeding the concentrations of 10 mg/L. In contrast, the concentrations of heavy metals in the sewage lagoon effluent were exceptionally low with the exception of zinc (14 mg/L).

The results of heavy metal analyses on filtered samples of groundwater show a different picture with very low concentrations. This suggests that the elevated concentrations of heavy metals in non-filtered samples are associated with fine soil particles present in these water samples.

Bacteriological Quality

The fecal coliform bacteria density in groundwater is shown in Figure 13 which indicates that some fecal bacteria were reaching distances of 60 m from the recharge basin. It is expected that if sequences of long flooding periods were held, the fecal coliform count in groundwater would tend to increase when newly infiltrated water arrives at the observation wells and then would decrease as infiltration continued.

The coliform removal was probably due to "filtering" at the surface and mortality in hostile and competitive subsurface environments. Filtering and competition, and hence the fecal coliform removal, can be expected to increase with continued infiltration because of increased surface clogging and increased bacterial populations in the soil.

It is reasoned that any bacterial population which may reach the groundwater discharge area will be further reduced by microbial activities present in wet peat deposits along the river.

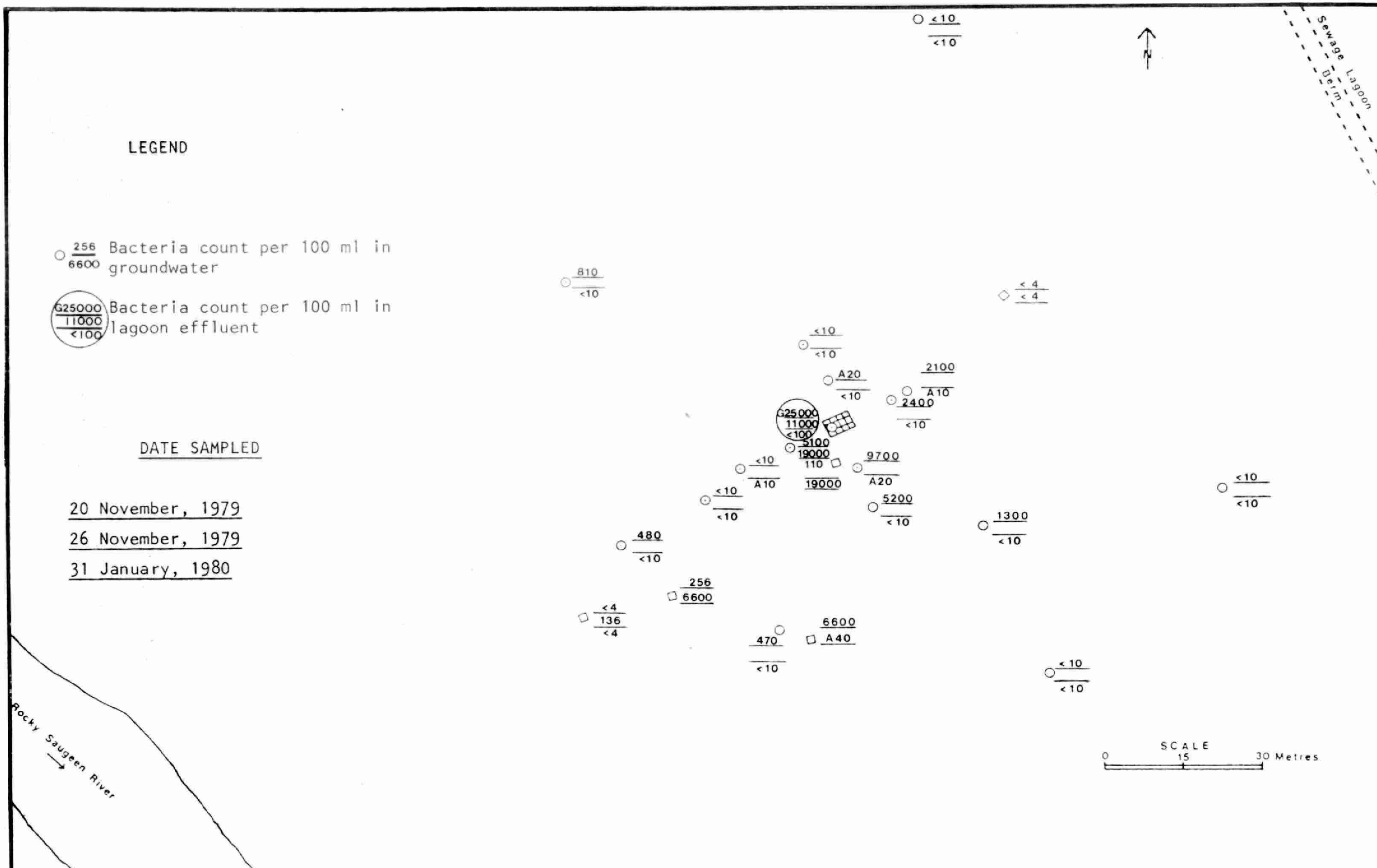


Figure 13. Map showing bacteriological quality of shallow groundwater.

Surface Water Quality

In order to assess whether there was any measurable effect on surface water quality, four sampling stations were established at strategic locations in the Rocky Saugeen River. In addition a few samples were obtained from two existing surface water ponds located in the immediate vicinity of the sewage lagoon. These two monitoring stations provided information with respect to possible infiltration of the effluent into the shallow water table aquifer directly from the lagoon.

The locations of the surface water sampling stations are given in Figure 1, while the results of qualitative analyses are provided in Appendices F and I.

Chemical Quality

The results of the chemical analyses obtained from the four sampling stations in the Rocky Saugeen River show that there was no measurable increase in any of the chemical constituents in the river due to the infiltration of about 8,020 m^3 of sewage effluent to the shallow groundwater system. This is understandable taking into account effluent dilution by groundwater, surface water and other attenuating processes in the groundwater, hydrologic and surface systems existing between the upper limit of the groundwater discharge area and the Rocky Saugeen River.

In actuality, the water quality of the river has much lower concentrations of almost all chemical constituents than background concentrations in the shallow groundwater except for pH and nitrate which are somewhat higher in the River. The river water is slightly on the alkaline side compared to the groundwater.

Concentrations of the anionic detergents were below the detectable limit (0.1 mg/L) in the samples obtained on November 3, 1970 at two sampling stations in the Rocky Saugeen River (upstream and downstream from the lagoon). No increase in the content of anionic detergent was revealed by the second set of samples taken from four sampling stations in the Rocky Saugeen River on November 21, 1979.

Although the elevation of the water table in the pond located immediately west of the lagoon is lower than the elevation of the bottom of the lagoon, it appears that water quality in the pond has not been affected by the leakage from the lagoon. It should be noted though, that during the course of pumpage of the effluent into the infiltration basin one hose developed a leak and as a consequence a small amount of the effluent found its way (along the ditch parallel to the berm) into this pond. This resulted in slight increases in the concentrations of several chemical parameters including a few components of the nitrogen cycle and phosphorous (Appendix F). A similar trend was exibited by anionic detergents which increased to 0.1 mg/L.

Heavy Metals

The concentrations of heavy metals in the river were exceptionally low at all four sampling points indicating that there was no measurable influence on their concentration in the river caused by the effluent infiltration, or due to the existance of the sewage system at this locality (Appendix F).

Bacteriological Quality

Bacterial counts in river water samples taken upstream and downstream from the study area were quite low (Appendix I). It is therefore concluded that rapid infiltration of the lagoon effluent into the coarse granular deposits has had no adverse effect on the bacteriological quality of the river water.

The presence of fecal coliform bacteria in the pond water located immediately west of the lagoon was most likely caused by leakage of the effluent from the pumping equipment which found its way to the pond.

DISCUSSION

Significance of the Recharge Mechanism and Groundwater Flow Systems

The resulting effect of the infiltration of the sewage lagoon effluent into granular deposits was the development of a groundwater hydraulic mound. Initially, the percolating water will move downward and then after reaching the water table, it radiates in all directions until the mounding effect has reached a steady state condition. From here on, the lateral movement of water will be only in the direction of the original groundwater gradient, that is towards the Rocky Saugeen River.

It is expected that a considerable mixing with native groundwater will occur to a certain depth largely depending on the direction of groundwater flow, the quantity of recharged wastewater and the permeability of the granular deposits. In this study, because large quantities of wastewater were infiltrated in a relatively small area, it appears that a bulk of recharged wastewater occupied or "floated" above the native groundwater and hence the lateral movement prevailed. Therefore, only a limited portion (up to 2 m) of the sand and gravel aquifer, an "active" (dynamic) zone, largely participated in the wastewater renovation (Figure 14).

In view of this situation, it is important to recognize the significance of the qualitative results of groundwater in relation to the depth from which the samples were obtained. For example, it is obvious that samples taken from the open test pits (TP-1 to TP-5) will be representative of the "active" zone of the shallow aquifer,

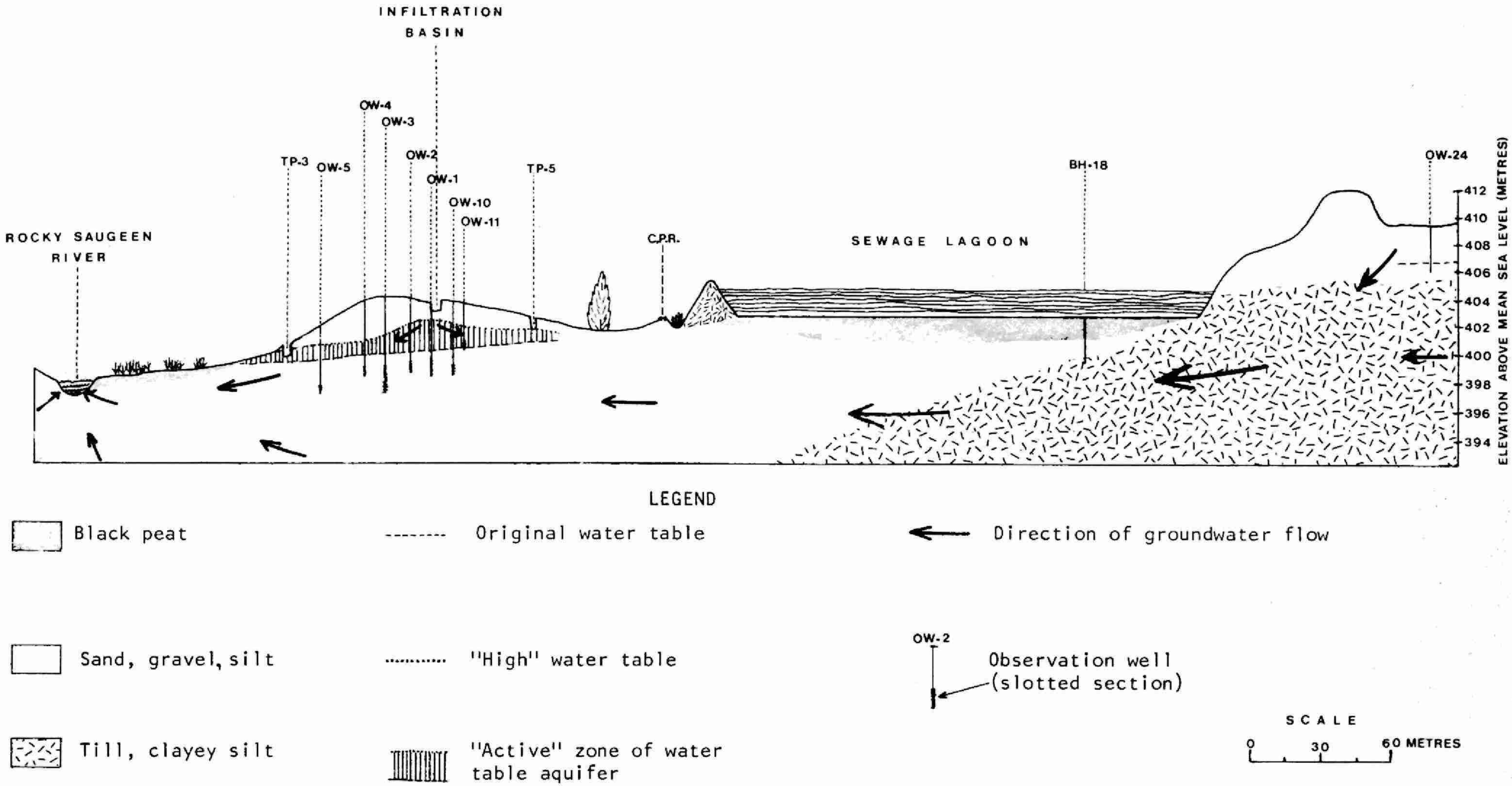


FIGURE 14. Conceptual model of the recharge mechanism and groundwater flow systems in the study area.

whereas some of the deeper observation wells would depict a portion of the aquifer which is less affected by infiltrated wastewater.

Furthermore, water quality in these deep wells seems to be affected by an "outside" source most likely agricultural fertilizers. Exfiltration from the lagoon may also be a contributing factor to some of the discrepancies in water quality results in the deeper observation wells. The mechanism of groundwater flow and the potential pollution sources likely influencing groundwater quality in the study area are schematically illustrated in Figure 14. This figure shows that any exfiltration from the lagoon which is probably insignificant at this time, because of self-sealing processes at the bottom of the lagoon would have an affect on the deeper portion of the sand and gravel aquifer system. The results of qualitative analyses obtained from several sampling stations support this conceptual model.

The bulk of the renovated water will be discharged in the newly formed groundwater discharge zone created by the rise of the water table, as well as in the original groundwater discharge zone, both constituting the section along the river about 80 m wide. The discharged groundwater will undergo further renovation while travelling overland through a wet, small cattail environment.

Finally, a small quantity of groundwater from the shallow aquifer will probably reach the river directly through the banks and river bed.

Potential Hydraulic Loading

The infiltration rates generated during the initial period of this study (first five days) could be used

as the potential or bench-mark infiltration rates since they were basically affected only by the permeability of the underlain sand and gravel deposits and were not influenced by clogging factors.

Using this data, the potential application rate could be as high as 32 $m^3/d/m^2$. This value should be increased by the amount of infiltration which will occur through the contact area of the effluent with the soil on three sides of the infiltration basin. This additional recharge rate will largely depend on the effluent depth maintained in the recharge basin.

More conservative loading rates are given in Table 2. Recharge rates given in this table represent an average rate generated during certain periods of time, under specific hydraulic and infiltration conditions of the recharge basin. For this reason, they should be considered more reliable than the former values.

The operational sequence of an infiltration system (inundation - dry up periods ratio) should be considered in close conjunction with optimal loading rates. In other words, inundation - dry up periods are highly influential factors to the optimal recharge rates.

General Design Aspects

A large-scale infiltration system for the renovation of wastewater from the sewage lagoon should be considered for design. Although not in abundance, the most favourable land appears to be the area located immediately northwest of the infiltration basin used in this study (Photo 3). The system may consist of a chain of elongated

recharge basins parallel to the Rocky Saugeen River. The effluent could be distributed into the basins by a channel which could run along the recharge strip. Since a low suspended solids content in the effluent would be advantageous in order to prolong flooding periods and therefore require minimum maintenance of the basins, a sedimentation reservoir could be constructed at the head of the channel system carrying the effluent to the recharge basin.

The following criteria may be used for the design of a system for renovating sewage lagoon effluent by groundwater recharge with infiltration basins at this locality.

1. During infiltration the depth to water table below the recharge basin should be at least 1.5 m. Maintaining a sufficiently thick unsaturated zone is necessary for aerobic decomposition of organic matter before it reaches the water table.

2. Since the above criteria may be difficult to achieve, an alternative would be oxygenation of sewage lagoon effluent by "splashing" into the basin.

3. The bottom of a recharge basin should be relatively flat with up to 1.0 m of relatively uniform sand maintained at its bottom. This imported filter material should be of slightly lower permeability than the parent material. The relatively thick sand filter will allow a longer time between additions of more sand, as clogged layers are removed.

Some Aspects of Recharge Basin Management

It would be difficult to predict the optimum wet/dry ratios without extensive operational experience.

This ratio will largely depend on the quality of the effluent at different times of the year and it may change accordingly. Therefore, the ratio should be determined by experimentation with the effluent in question. The inundation period is dictated mainly by aerobic conditions in the sand filter and in the ground, whereas the dry up period serves to dry the sediment and algae layer and to allow oxygen to penetrate the sand filter and the unsaturated material below it (Hore, 1980).

Initially, a large operation system with infiltration basins, longer inundation periods alternated with dry up periods (suggested initial ratio is 10:6) should be used to achieve maximum efficiency. Because of relatively high suspended solids in the sewage lagoon effluent, basically present in the form of organic matter, it is a matter of time until these suspended solids accumulate at the bottom of the basin (sludge layer), thus reducing infiltration rate to a certain degree. It is expected that upon drying up, the sludge layer would shrink and brake up into curled up flakes.

Initially, dry up periods may help to restore original infiltration rates without the help of any device. However, if necessary, at the end of dry up periods the basin could be raked or harrowed using manual labour only (hand operation). This procedure may be repeated at the end of each dry up period until such time that infiltration rates are reduced by build up of a thicker sludge layer thus necessitating its physical removal. Again, hand operation should be employed to accurately remove a small amount of ("shaving" of the basin bottom) the sludge and sand filter followed by harrowing, if necessary. Use and movement of any heavy vehicle will have a negative effect on the basin's performance because it will compact the sand filter thus causing permanent reduction of its permeability and consequently

decreasing infiltration capabilities in a recharge basin. In any event, the removal of the top of the sand filter should be done as infrequently as possible to maintain the biologically active (top) layer in the sand filter (Hore, 1980).

After a certain period of basin operation, it may be necessary to replace the thin (top) layer of granular material at the bottom of the basin. The usual practice of filter removal and replacement is to place a uniform layer of sand up to 1 m thick in the bottom of a basin, and remove several centimeters of this sand as it becomes clogged. Another layer of sand is placed in the basin only after the removal of the top layer reduces the original filter to about 0.3 m (Sibul, 1980). The medium sand filter is used because (a) this type of material would act as an immediate filtering media and would retain most of the suspended solids near the bottom of the basin thus minimizing the possibility of formation clogging at a greater depth and (b) it was found that granular material with larger pore space recovered its infiltration capacity more slowly than those with small pore spaces.

The effect of rainfall during dry up periods on basin performance could be significant in either reducing or improving the infiltration rate. It was observed that rain drops tend to brake the accumulated sludge layer (while it was still wet) and wash it into the soil.

An example of the effect of rainfall and snow on the basin partially clogged with a sludge layer is illustrated in Photos 11 and 12. Photo 11 shows the situation of the "unshaved" bottom of the basin at the end of the infiltration study (November 26, 1979). Rain and snow actions have "purified" it as illustrated by Photo 12 taken on April 19, 1980. Actually, all suspended solids from the surface were moved "inside", thus affecting several centimetres of granular material immediately below the bottom of the basin.

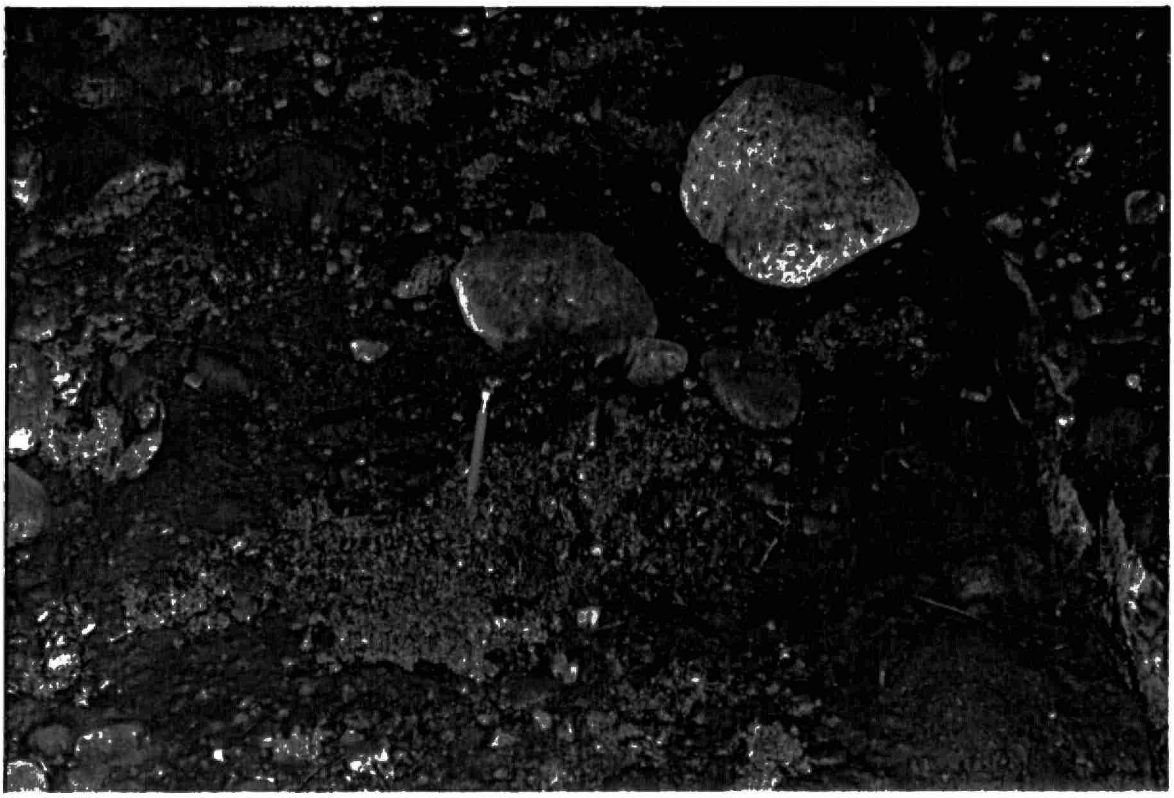


Photo 11. A thin sludge layer accumulated at basin bottom at the end of the infiltration study November 26, 1979 had slightly reduced infiltration rate.

Photo 12. Rainfall and winter weather conditions had "shaved off" the basin left partially clogged with a thin sludge layer at the end of the infiltration study shown in Photo 11.

Photo taken on April 19, 1980.

Other aspects of an efficient management of an infiltration system would be learned during its actual operation.

Winter Operating Constraints

In a climatic region such as the Dundalk upland in which the Village of Markdale is located, with sub-zero temperatures which may last over four months, operation of an infiltration system for the lagoon effluent during the winter months could pose serious difficulties. Notable concerns are discussed as follows:

1. During the sub-freezing temperature, as long as the inundation period is continued, there is little danger (with some exceptions) that the bottom of the basin may freeze resulting in building up of ice and snow. Build up of ice and snow would disrupt smooth continuation of the operation of the system.

2. Pump failure, or basin clogging would eventually necessitate stoppage of the basin inundation resulting in accumulation of ice and snow.

3. A severe blizzard accompanied with strong winds may generate large snow drifts into the infiltration basin, thus obstructing continuous operation. Although infrequent, this could provide a seriously disruptive condition.

4. Research shows that application of waste water from the stabilization pond did not prove to be effective for melting snow and preventing ice accumulation. Therefore, continuous flooding at the time of the earliest

hard freeze might provide an insulating cover of snow thus enabling continuation of recharge into early winter. This would be possible provided that snow would not accumulate in such large quantities from the blizzard or snow drifts.

5. It is also anticipated that a greater depth of waste water in the infiltration basin would be advantageous during the early winter to extend the infiltration period under the ice. Therefore, if the flooding period is continued at least one month beyond the freezing date, the necessary winter storage of waste water would be less than four months.

6. Because of freezing soil conditions and other adverse weather effects, basin cleaning and drying in the winter will not be practical. If the infiltration rate is reduced to near zero while water remains in the infiltration basins, their renovation in the spring will be difficult. The remaining water would have to be pumped out in order to clean the basin filters (Hore, 1980).

Considering these adverse factors, it is doubtful that the efficient (if any) operation of the system during the winter months can be accomplished.

CONCLUSIONS

1. The results of a rapid infiltration study of sewage lagoon effluent renovation with an infiltration basin, carried out from October 19 till November 26, 1979, showed that wastewater can be effectively renovated by this method. In an operational system, the basin would be located immediately northwest of the basin used in this study, but generally parallel with the Rocky Saugeen River.

2. An infiltration of over 700 m/year of the lagoon effluent can be obtained with tentative flooding periods of 6 to 10 days alternated with dry up periods of 5 to 6 days. These are tentative suggestions, but experience gained from an operational system would provide data for optimal and more firm operational schedules.

3. The response of the water table aquifer beneath the infiltration basin and in close proximity to it, enabled an evaluation of the vertical and horizontal hydraulic conductivity of the aquifer. The values of hydraulic properties of the shallow aquifer can be used in the design of an operational infiltration system to predict underground detention times and water table configuration for various shapes of the recharge basin.

4. The attenuation processes in sand and gravel deposits effected complete removal of dissolved reactive phosphorous.

5. Free ammonia was entirely converted into total Kjeldahl nitrogen at a distance of less than 40 m, whereas over 40 percent of Kjeldahl nitrogen was removed or converted into nitrate at the same distance from the

recharge basin. Nitrate concentrations were still relatively high. Short, frequent inundations of the basin alternated with equally long dry up periods, would probably yield the most complete conversion of nitrogen in the effluent water to nitrate in the renovated water. This short inundation period may be performed when the need for it arises.

6. The renovation processes in the granular materials yielded almost complete removal of fecal coliform bacteria at a distance of about 60 m from the recharge basin.

7. There was no indication of gradual clogging of the formation at depth, although a thin layer of sludge matter gradually accumulated at the bottom of the infiltration basin thus reducing, to some degree the recharge rate. With periodic "shaving off" and the replacement of the granular material at the bottom of the basin a rapid infiltration system for renovating sewage lagoon effluent should have a long, useful life.

RECOMMENDATIONS

Based on the results of this study it is apparent that the approach using an infiltration basin system can be utilized on an operational scale for tertiary treatment of sewage lagoon effluent. However, a careful evaluation of the present sewage flow, 15-to 20-year projected sewage flow and subsequently required storage capacity in conjunction with the operational mode of the rapid infiltration system should be carefully assessed before the design stage is undertaken.

In the light of some uncertainty with respect to lithological conditions in the study area (as indicated by geophysical survey) it is required that

- At least three test holes should be completed into the bedrock in order to obtain more accurate information as to the thickness and nature of the overburden.

The data obtained may clarify any possible impact on groundwater use in the area (Markdale municipal wells). This should be completed before the design stage is undertaken.

It appears that the most favourable area (considering just the area between the river and CPR tracks) for the establishment of an operational system is located immediately northwest from the infiltration basin used in this study. Additional field investigation may be necessary to confirm that this prospective area consists of permeable sand and gravel deposits. This could be accomplished with the help of a backhoe.

However, the available land between the Rocky Saugeen River and CPR tracks is insufficient to accommodate the entire sewage lagoon effluent in an operational infiltration system. For this reason, the field investigation should also include an assessment of the availability of the additional land which will be suitable for sewage effluent treatment by rapid infiltration. The property immediately west of the sewage lagoon appears to be quite promising.

If the permanent infiltration system is installed, the important water quality parameters should be monitored as well as the long term water level response to recharge. The formation clogging aspects should also be studied. Underground detention time should be monitored along with renovated groundwater "polishing" by biological processes in the groundwater discharge area in the wet section near the river.

It is suggested that the municipality engage a consultant for the expansion of the sewage works based on a groundwater recharge approach philosophy. Data collected during this study and presented in this report should serve as a basis for the design of an operational system with infiltration basins.

The consultant should work closely with the staff of this Ministry in view of the innovative nature of this treatment method and to ensure that all concerns are adequately resolved before proceeding to final design.

ACKNOWLEDGEMENTS

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Messrs. Denis Veal and Daniel Brown read the manuscript and made many valuable suggestions.

Messrs. Ron Hore and Ulo Sibul, Water Resources Branch reviewed the draft report and gave much valuable and constructive criticisms and suggestions. Dr. E. Rodrigues and his staff of Geotechnical Services, Water Resources Branch carried out a geophysical survey in the study area.

The field work was carried out by the author and Mr. Tom Ervasti. The levelling survey was performed by Mr. Brian Jaffray and grain size analyses by Mr. Steve Check. Drafting and assemblage of the appendices were carried out by Miss Nancy Rennie and Mr. Francois Sylvestre.

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APPENDIX A

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

bservation ell or test it	Date completed D.M.Y.	Ground elevation a.m.s.l. (m)	Total well (pit) depth (m)		Depth to water level at time of completion (m)	"Screen" details		Lithologic log	
			At time of completion	On April 19 1980		Depth to top (m)	Length (m)	Depth (m)	Description
OW-1	10/09/79	403.97	5.49	4.79	3.53	3.49	2.0	0 - 0.83	Sand, gravel (recharge pit)
								0.83- 3.8	Sand, gravel, minor silt
								3.8 - 5.5	Sand, gravel, silt, clay layers
OW-2	05/09/79	404.02	5.30	5.14	3.61	4.30	1.0	0 - 4.0	Sand, gravel, slight silt
								4.0 - 5.5	Sand, gravel, some clayey silt
OW-3	05/09/79	404.25	7.0	6.85	4.15	5.0	2.0	0 - 4.0	Sand, gravel with cobbles
								4.0 - 4.9	Sand, silty with gravel
								4.9 - 7.6	Till, clayey silt, fine gravel
OW-4	05/09/79	403.97	5.6	5.78	3.77	4.60	1.0	0 - 3.1	Sand, gravel, some silt
								3.1 - 6.1	Sand, gravel, some silt
OW-5	05/09/79	402.30	5.20	5.06	2.49	4.20	1.0	0 - 3.7	Sand, gravel, minor silt
								3.7 - 5.5	Gravel, cobbles, silt

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

Observation well or test pit	Date completed D.M.Y.	Ground elevation a.m.s.l. (m)	Total well (pit) depth (m) At time of completion	Total well (pit) depth (m) On April 19 1980	Depth to water level at time of completion (m)	"Screen" details Depth to top (m)	"Screen" details Length (m)	Lithologic log Depth (m)	Lithologic log Description
OW-6	10/09/79	403.95	5.70	4.59	3.36	4.70	1.0	0 - 4.0	Sand, gravel, slight silt
								4.0 - 5.8	Sand, gravel, silt layering
								5.8 - 6.1	Till, clayey silt, massive
OW-7	10/09/79	403.90	5.34	4.82	3.31	4.34	1.0	0 - 4.1	Sand, gravel, slight silt
								4.1 - 5.9	Sand, gravel, silt layering
								5.9 - 6.1	Till, clayey silt, massive
OW-8	05/09/79	404.16	5.30	5.00	2.77	4.30	1.0	0 - 5.5	Sand, gravel, some cobbles, slight silt
OW-9	05/09/79	404.04	5.30	5.4	3.76	4.30	1.0	0 - 5.5	Sand, gravel, some cobbles, slight silt
OW-10	10/09/79	403.90	5.34	4.38	3.23	4.34	1.0	0 - 4.0	Sand, gravel, slight silt
								4.0 - 5.5	Sand, gravel, silt, clay layers
OW-11	15/08/79	403.68	3.40	3.5	3.26	2.40	1.0	0 - 2.4	Gravel, cobbles, sand minor silt
								2.4 - 3.4	Sand, medium gravel, light silt

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

Observation well or test pit	Date completed D.M.Y.	Ground elevation a.m.s.l. (m)	Total well (pit) depth (m)		Depth to water level at time of completion (m)	"Screen" details		Lithologic log	
			At time of completion	On April 19 1980		Depth to top (m)	Length (m)	Depth (m)	Description
OW-12	15/08/79	403.44	2.80	2.9	2.55	1.8	1.0	0 - 0.5	Gravel, sand
								0.5 - 2.8	Gravel, sand fine to coarse, minor silt
OW-13	15/08/79	402.31	2.70	2.7	2.46	1.7	1.0	0 - 2.7	Sand, gravel, coarse very slight silt
OW-14	15/08/79	401.90	2.0	2.18	1.44	1.0	1.0	0 - 1.5	Gravel, cobbles with sand, silty
								1.6 - 2.0	Gravel, very silty
OW-15	20/07/79	402.81	2.10	1.7	2.05	1.6	0.5	0 - 1.7	Gravel, cobbles, silty minor clay
								1.7 - 2.1	Gravel, silt, sandy
OW-16	20/07/79	402.75	3.00	2.5	1.81	2.0	1.0	0 - 2.0	Gravel, cobbles, silty with clay
								2.0 - 3.0	Gravel, sand, silty
OW-17	20/07/79		3.00	2.45	dry	2.0	1.0	0 - 1.4	Cobbles, boulders with gravel, sand, silty
								1.4 - 3.0	Sand, fine gravel, clean
OW-18	10/09/79	405.53	6.10	5.65	5.89	5.1	1.0	0 - 6.1	Sand, gravel, little to no silt
OW-19	20/07/79		3.90	2.76	dry	2.9	1.0	0 - 3.9	Sand, gravel coarse with cobbles, little or no silt

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

Observation well or test pit	Date completed D.M.Y.	Ground elevation a.m.s.l. (m)	Total well (pit) depth (m) At time of completion	On April 19 1980	Depth to water level at time of completion (m)	"Screen" details Depth to top (m)	Length (m)	Lithologic log Depth (m)	Description
OW-20	20/07/79		3.50		dry	2.5	1.0	0 - 2.7	Cobbles, boulders, coarse sand and gravel, silt
								2.7 - 3.5	Gravel, coarse with silty sand
OW-21	20/07/79	402.78	2.70	2.14	2.23	1.7	1.0	0 - 1.5	Cobbles, boulders with sand, silty
								1.5 - 2.7	Sand, gravel, little silt
OW-22	20/07/79	407.54	2.71	2.86	2.69	1.7	1.0	0 - 2.3	Gravel, cobbles sand
								2.3 - 2.7	Silt, sandy, dense
								2.7 - 3.9	Till, clayey silt
OW-24	14/09/79	409.83	3.50	2.85	3.12	2.5	1.0	0 - 3.5	Sand, medium with gravel, slight silt
TPB-1	20/07/79		3.5	backfilled	dry			0 - 2.8	Gravel, cobbles, very silty with sand
								2.8 - 3.5	Silt, sand, clay
TPB-2	20/07/79		3.9	backfilled	dry			0 - 2.1	Cobbles, boulders, coarse sand, gravel, silty
								2.1 - 3.9	Silt, sandy, dense
TPB-5	20/07/79		3.9	backfilled	dry			0 - 2.0	Gravel, cobbles, silty with sand
								2.0 - 3.9	Gravel, coarse, silty

SUMMARY OF LITHOLOGICAL LOGS FOR OBSERVATION WELLS AND TEST PITS

Observation well or test pit	Date completed D.M.Y.	Ground elevation a.m.s.l. (m)	Total well (pit) depth (m)		Depth to water level at time of completion (m)	"Screen" details		Lithologic log	
			At time of completion	On April 19 1980		Depth to top (m)	Length (m)	Depth (m)	Description
TPB-6	20/07/79		3.9	backfilled	dry			0 - 3.9	Gravel, cobbles, with coarse sand, silty
TP-1	29/10/79	403.9	2.5		dry			0 - 0.3	Top soil, silty
								0.3 - 2.5	Sand, gravel, occasionally silty
TP-2	29/10/79	402.06	1.5					0 - 0.4	Top soil
								0.4 - 1.5	Gravel, sand, coarse minor silt
TP-3	29/10/79	400.60	1.0					0 - 0.2	Top soil, silty
								0.2 - 1.0	Gravel, sand, silty clayey
TP-4	29/10/79	402.32	1.5					0 - 0.36	Top soil, silty, sandy
								0.36- 1.5	Sand, gravel, silt
TP-5	29/10/79	402.78	1.4					0 - 0.35	Top soil
								0.35- 1.4	Gravel, sand, silty, clayey

APPENDIX B

GRAIN SIZE ANALYSES OF SURFICIAL DEPOSITS

GRAIN SIZE DISTRIBUTION

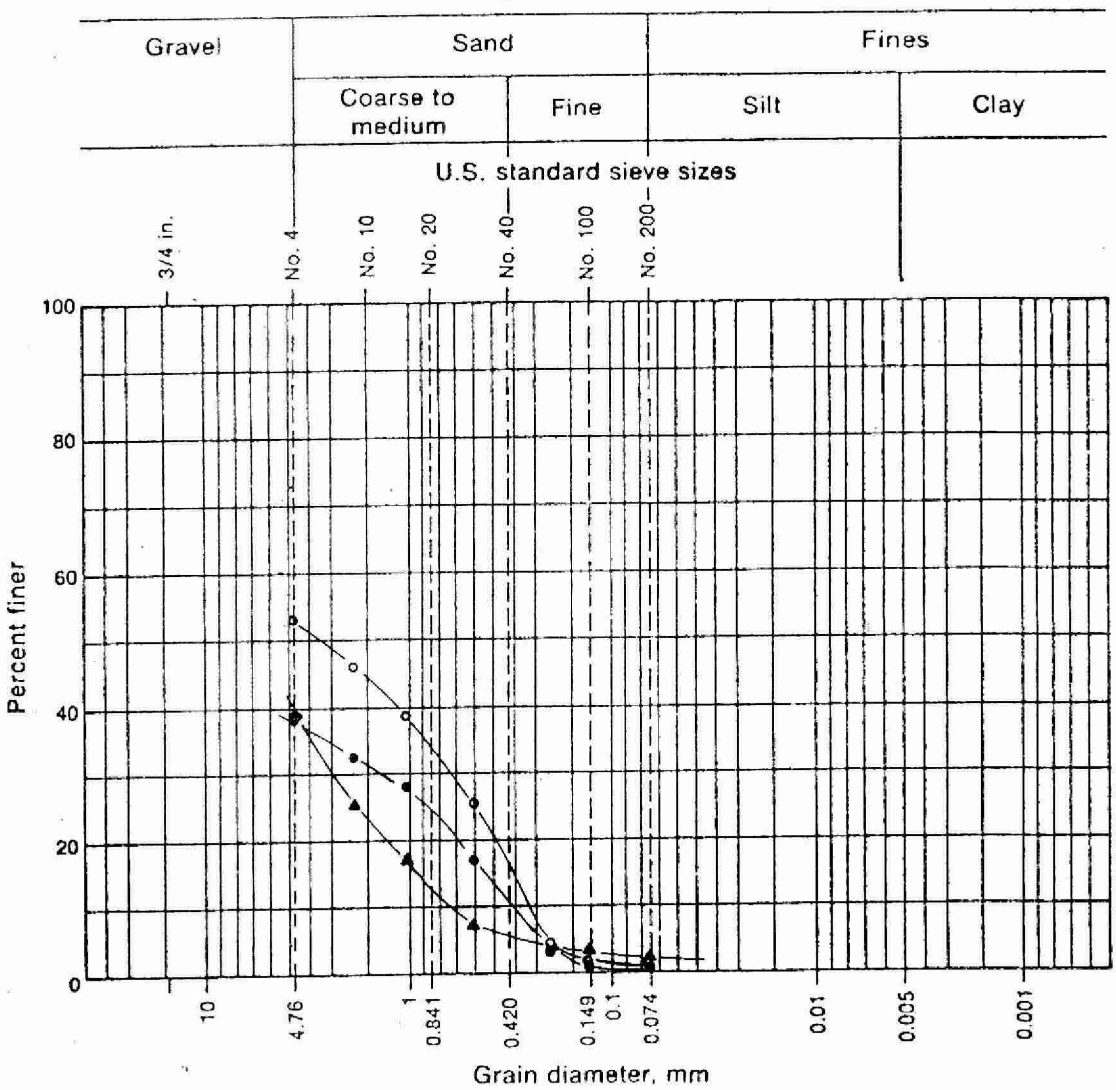
Project Study of sewage lagoon effluent renovation by rapid infiltration

Location of Project Markdale Boring No. ______ Sample No. ______

Description of Soil ______ Depth of Sample ______

Tested By. Steve Check Date of Testing January, 1980

Date sampled: October, 1979



LEGEND

Test pit no.	Depth (m)	Symbol	Soil Description
1	0.61	—▲—	Gravel with coarse sand, some fines
1	1.22	—○—	Gravelly sand with some fines
1	1.83	—●—	Gravel with coarse sand, some fines

GRAIN SIZE DISTRIBUTION

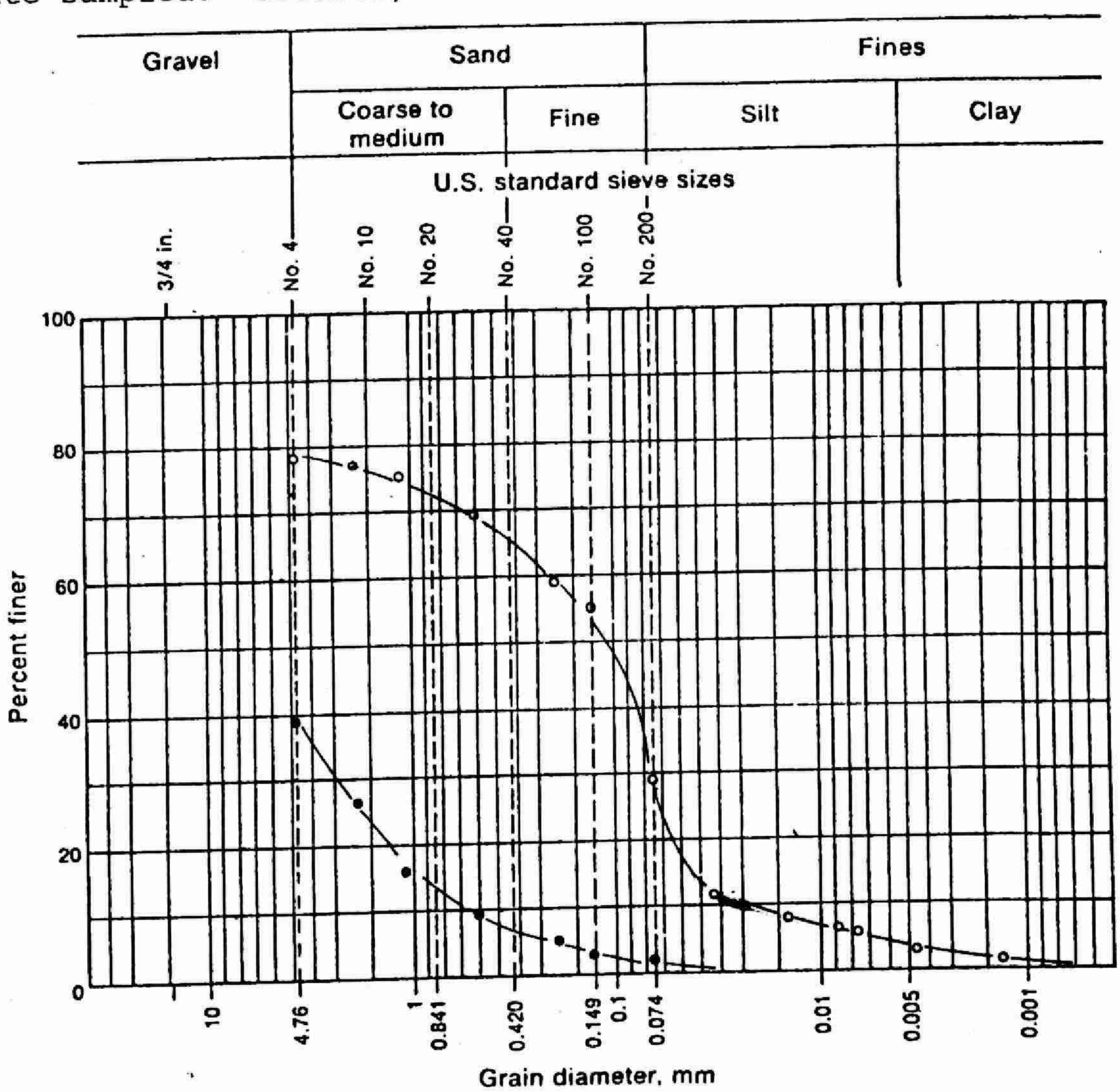
Project: Study of sewage lagoon effluent renovation by rapid infiltration

Location of Project: Markdale Boring No. ______ Sample No. ______

Description of Soil: ______ Depth of Sampl. ______

Tested By. Steve Check Date of Testing: January, 1980

Date sampled: October, 1979



LEGEND

Test pit no.	Depth (m)	Symbol	Soil Description
2	0.61	—●—	Gravel with coarse sand, some fines
3	0.46	—○—	Gravelly sand with some silt and clay

GRAIN SIZE DISTRIBUTION

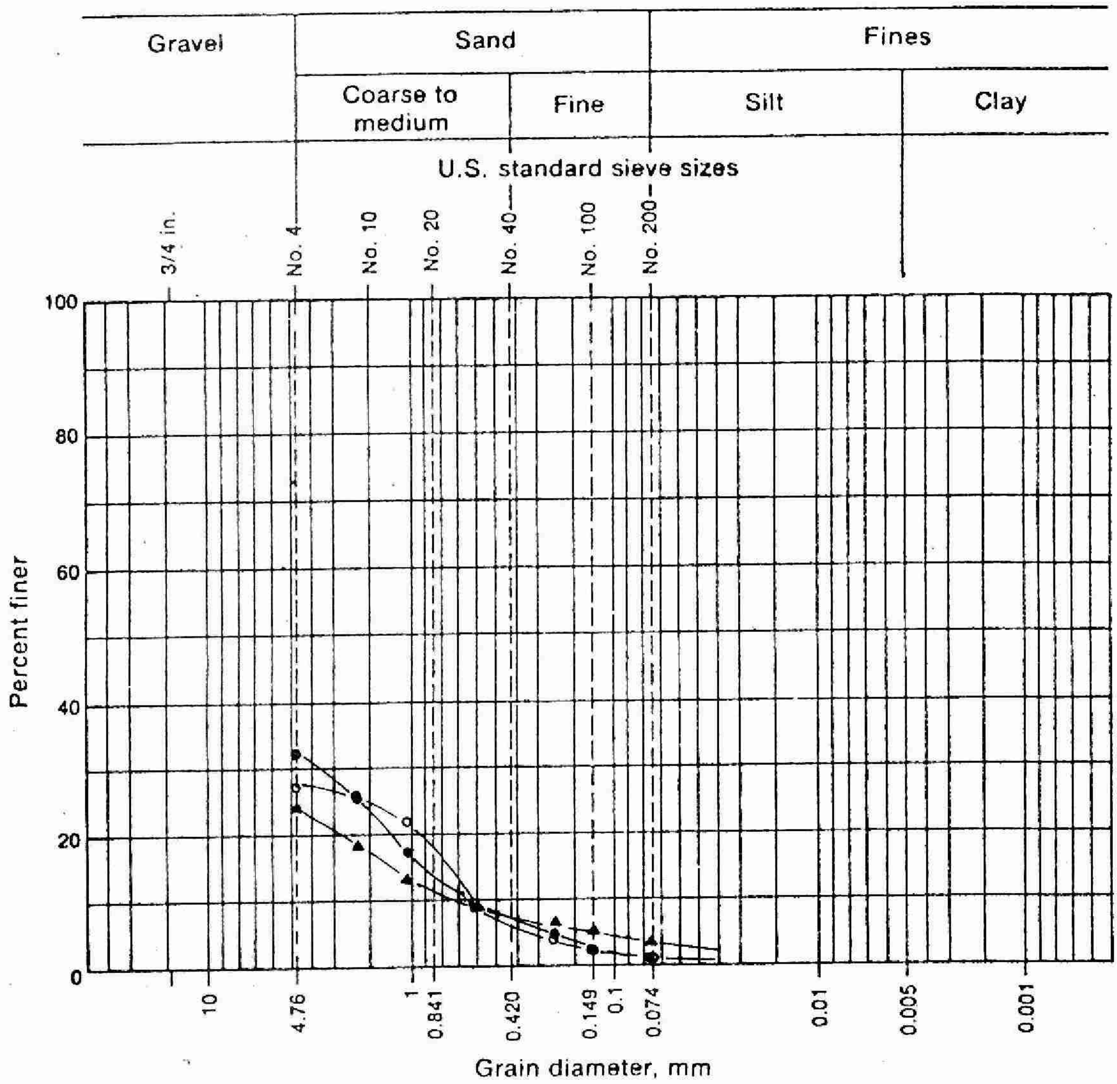
Project Study of sewage lagoon effluent renovation by rapid infiltration

Location of Project Markdale Boring No. ______ Sample No. ______

Description of Soil ______ Depth of Sample ______

Tested By. Steve Check Date of Testing January, 1980

Date sampled: October, 1979

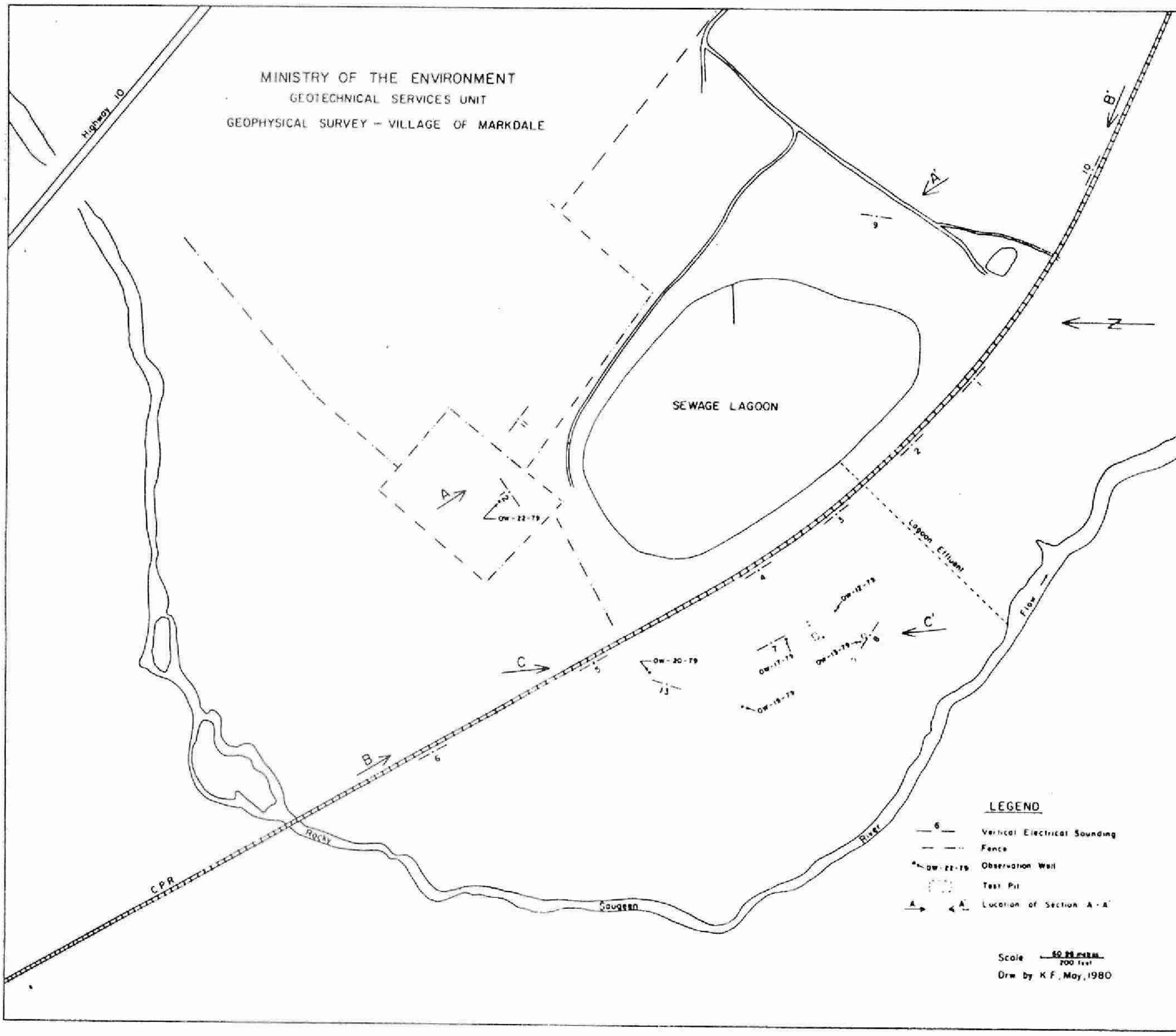


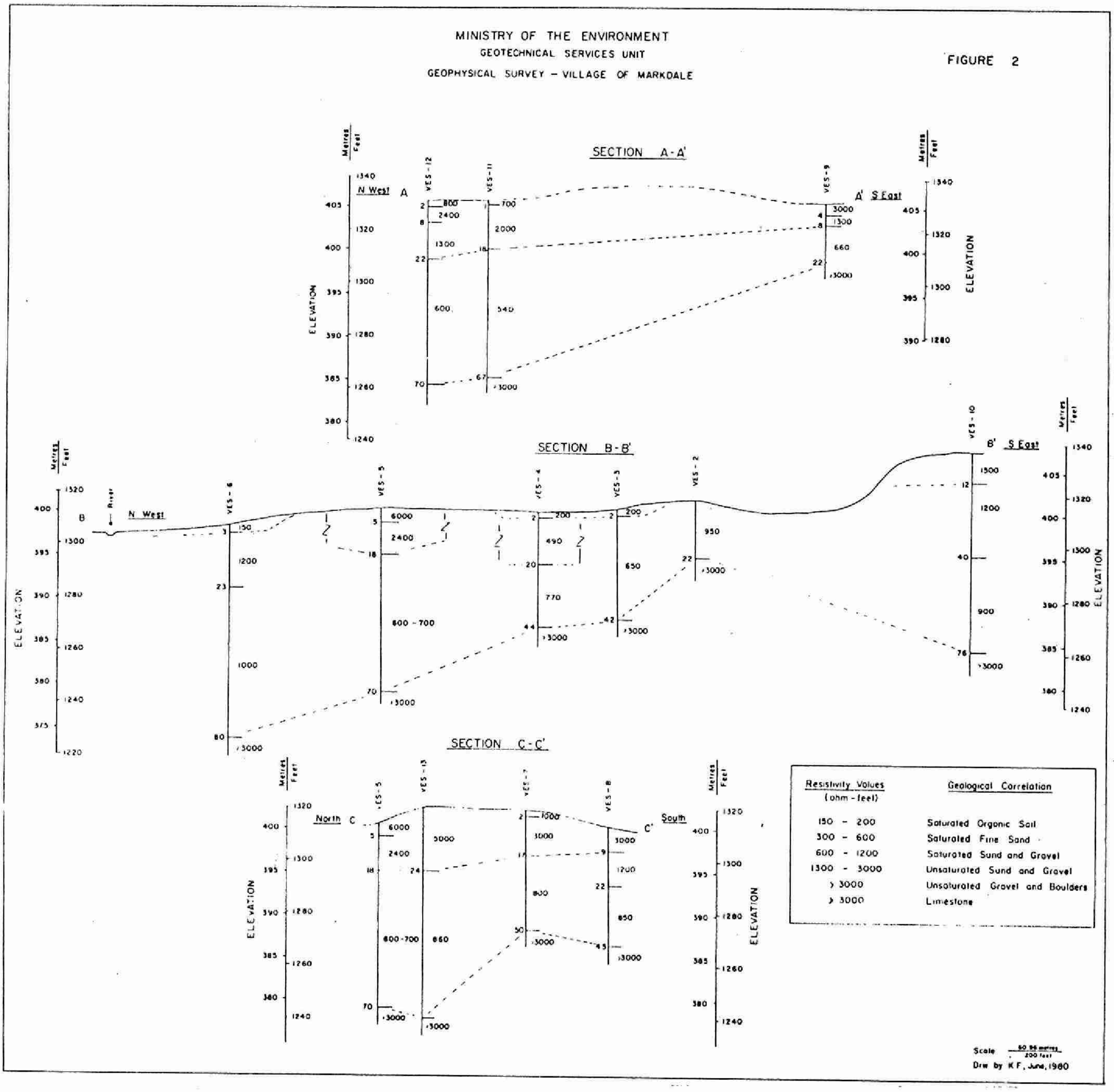
LEGEND

Test pit no.	Depth (m)	Symbol	Soil description
4	0.4	—▲—	Gravel with coarse sand some fines
4	0.73	—○—	Gravel with coarse sand some fines
4	1.22	—●—	Gravel with coarse sand some fines

APPENDIX C

RESULTS OF GEOPHYSICAL SURVEY


MINISTRY OF THE ENVIRONMENT
GEOTECHNICAL SERVICES UNIT
GEOPHYSICAL SURVEY – VILLAGE OF MARKDALE
Highway 10
SEWAGE LAGOON
Lagoon Effluent
Flow
CPR
Rocky
Saugeen
River
OW-22-79
OW-20-79
OW-17-79
OW-18-79
OW-12-79
OW-13-79
LEGEND
Vertical Electrical Sounding
Fence
Observation Well
Test Pit
Location of Section A - A'
Scale
200 feet
Drw by K.F., May, 1980


MINISTRY OF THE ENVIRONMENT
GEOTECHNICAL SERVICES UNIT
GEOPHYSICAL SURVEY – VILLAGE OF MARKDALE
FIGURE 2
SECTION A-A'
SECTION B-B'
SECTION C-C'
ELEVATION
Metres
Feet
N West
S East
North
South
Resistivity Values (ohm - feet)
Geological Correlation
150 - 200 Saturated Organic Soil
300 - 600 Saturated Fine Sand
600 - 1200 Saturated Sand and Gravel
1300 - 3000 Unsaturated Sand and Gravel
> 3000 Unsaturated Gravel and Boulders
> 3000 Limestone
Drw by K.F., June, 1980

APPENDIX D

SUMMARY OF WATER WELL RECORDS

Ministry of the Environment
Ontario

SUMMARY OF WATER WELL RECORDS

Southwestern Region
Technical Support Section
985 Adelaide St. South, London N6E 1V3

County: GREY **Township(s):** GLENELG **Date compiled:** 19/04/80 **Compiler:** N. RENNIE

Well number[1]	Location: Township	Location: Lot	Location: Concession	Elevation, in feet	Owner	Driller	Date drilled D/M/Y	Well diameter, in inches	Length of casing, in feet	Well depth, in feet	Depth water found, in feet	Original static level, in feet	Pumping test: Drawdown, in feet	Pumping test: Pumping rate, in Igpm	Pumping test: Duration of pumping, hrs	Kind of water[2]	Water use[3]	Well log and remarks
1301	G	90	II W.T.S.R.	1380	ALVIN FOSTER	M. BELLERBY	23/06/51	4	111	138	138	20	10	6.6	1	FR	DO ST	0-21 DUG WELL 21-111 SAND and CLAY 111-138 LIMESTONE ROCK
4325	G	100	II W.T.S.R	1370	AUGUST STRAUTNIERS	M&S WELL DRILLING	21/08/73	4	30	105	87 102	46	29	4	-	FR	DO	0-4 BROWN FILL 4-21 HARDPAN 21-29 GRAVEL, STONES 29-52 GREY BROKEN LIMESTONE 52-105 BROWN LIMESTONE
4655	G	100	II W.T.S.R	1360	ALLAN OLSEN	RAY SPENCER WELL DRILLING	18/06/74	4	63	146	118	25	65	14	2.5	FR	DO	0-2 TOPSOIL 2-17 GRAVEL 17-26 CLAY, GRAVEL 26-62 GRAVEL, SAND 62-146 BROWN LIMESTONE
4658	G	100	II W.T.S.R	1355	GORD HEDGES	"	17/06/74	4	63	90	83	24	16	24	2.75	FR	DO	0-2 TOPSOIL 2-17 GRAVEL 17-26 CLAY, GRAVEL 26-62 BROWN GRAVEL 62-90 BROWN LIMESTONE
3125	G	96	III W.T.S.R	1350	R. I MEIKLEHAM	ALLAN LOUCKS	3/11/69	5	67	106	100	60	15	10	6	FR	DO	0-67 CLAY, GRAVEL 67-107 YELLOW LIMESTONE
3349	G	91	I W.T.S.R	1325	D.L. THOMSON	"	14/10/70	5	82	98	90	-1	-	20	6	FR	DO	0-82 CLAY, GRAVEL 82-98 YELLOW LIMESTONE
1665				1390	E TRAFFORD	M.S. BELLERBY	29/04/63	5	43	94.5	-	-	-	-	-	-	CO	0-43 STONEY GRAVEL, CLAY 43-94.5 GREY LIMESTONE
4198		100	II W.T.S.R	1350	J. BROPHY	ALLAN LOUCKS	18/06/73	5	45	100	95	27	13	10	4	FR	DO	0-45 BROWN CLAY, GRAVEL 45-80 GREY LIMESTONE 80-100 BROWN LIMESTONE
4218		101	II W.T.S.R	1370	MARKDALE LEGION	JIM CLARKE WELL DRILLING	26/01/73	5	30	111	62	35	55	5	1	FR	CO	0-5 BROWN CLAY 5-30 CLAY, GRAVEL 30-90 BROWN LIMESTONE 90-111 GREY LIMESTONE

[1] Location is shown in Figure [2] FR - fresh; SA - salty; SU - sulphur; MN - mineral. [3] DO - domestic; ST - stock; IR - irrigation; IN - industry; CO - commercial; MU - municipal; PS - public supply; CA - cooling or air conditioning.

MOE 0488 11/78

Ministry of the Environment
Ontario

SUMMARY OF WATER WELL RECORDS

Southwestern Region
Technical Support Section
985 Adelaide St. South, London N6E 1V3

County: GREY Township(s): GLENELG Date compiled: 19/04/80 Compiler: N. RENNIE

Well number[1]	Location: Township	Location: Lot	Location: Concession	Elevation, in feet	Owner	Driller	Date drilled D/M/Y	Well diameter, in inches	Length of casing, in feet	Well depth, in feet	Depth water found, in feet	Original static level, in feet	Pumping test: Drawdown, in feet	Pumping test: Pumping rate, in Igpm	Pumping test: Duration of pumping, hrs	Kind of water[2]	Water use[3]	Well log and remarks
4533				1351	MIN. OF THE ENVIRONMENT	F.E. JOHNSTON DRILLING CO. LTD.	15/8/73	8	10	240	110 134	27	45	400	24	FR	MU	0-10 BROWN SAND 10-56 SAND, ROCK, GRAVEL 56-71 GRAVEL, ROCK 71-240 GREY, BROWN LIMESTONE
4534				1365	"	"	31/7/73	8	19	232	56 115 128 203	17	35	200	24	FR	MU	0-4 BROWN SAND 4-131 WHITE BROWN DOLOMITE 131-225 GREY WHITE DOLOMITE 225-232 RUST SHALE
4799				1360	MAGEE CARSON	RAY SPENCER WELL DRILLING	24/07/74	4	54	90	75 88	14	11	20	1	FR	DO	0-3 BROWN FILL 3-5 BLACK TOPSOIL 5-53 GRAVEL 53-64 BROWN LIMESTONE 64-90 WHITE LIMESTONE
5872	G	100	II WTSR.	1350	PETER STRAIN	"	4/09/76	5	57	146	135	20	55	8	2.25	FR	DO	0-22 GRAVEL 22-29 RED CLAY 29-55 GRAVEL 55-146 LIMESTONE

[1]Location is shown in Figure . [2]FR – fresh; SA – salty; SU – sulphur; MN – mineral. [3]DO – domestic; ST – stock; IR – irrigation; IN – industry; CO – commercial; MU – municipal; PS – public supply; CA – cooling or air conditioning.

MOE 0488 11/78

APPENDIX E

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* OW1	OBSERVATION WELL NO. 1				12/09/79		368	340	0.15	7.9			730		42	11	80	41	20	4.5	0.3	1.4	.02	0.1	.04	.76	
"	"				18/10/79 11:34																						1.0
"	"				" 17:04		325	299	0.98	7.52			750		36.0	36.0	77.0	32.2	29.5	1.50	0.010	0.62	0.011	4.39	0.007	0.046	1.5
"	"				" 18:45		344	272	*<0.01	7.37			720		*39.5	*30.5	83.5	32.8	*32.0	*1.55	*0.030	*0.69	*0.137	*3.82	*0.009	*0.028	
"	"				19/10/79 14:32		304	301	*0.08	7.52			770		56.5	*45.5	73.0	29.4			*0.355	*1.51	*0.83	*1.97	*0.013	*0.059	<1.0
"	"				"		279	269	*0.03	7.49			760		55.0	*41.0	64.0	29.0		*3.5	*0.125	*1.43	*0.030	*0.54	*0.027	*0.086	<1.0
"	"				23/10/79		279	278	*0.24	7.54			782		55.0	*48.0	67.0	27.0	51.5	*7.70	*4.4	*4.4	*0.235	*0.36	*0.215	*0.570	1.5
* "	"				24/10/79		262	276	0.22	7.73			778		55.5	41.0	60.5	26.8	51.5	7.65			0.157	0.46	0.460	0.720	1.5
* "	"				28/10/79		272	284	3.05	7.91			780		56.5	41.0	62.5	28.0	51.5	8.30	5.0	6.30	0.355	0.14	0.340	0.380	1.5

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I, W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			
OW 1	OBSERVATION WELL NO. 1				18/10/79 11:34			73.0	15.0	88.0										1.0		<.25	2.0		0.50	36			
"	"				" 17:04			74.5	11.0	85.5																			
"	"				" 18:45	7.6	53																						
"	"				19/10/79 14:32			70.5	23.0	93.5																			
"	"				"			70.5	22.5	93.0																			
"	"				23/10/79			70.5	29.5	100.0																			
* "	"				24/10/79			68.5	29.5	98.0																			
* "	"				28/10/79			69.0	26.0	95.0					<.001	0.002	0.06	<.005	<0.02	0.02		<0.03	0.23	<0.02	<.01				

[1] Location is shown in Figure 2; N.D. – Not Detected; P – Present; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 1–A

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm–25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW1	OBSERVATION WELL NO. 1				31/10/79		266		0.80								67.0	23.6	51.0	8.25		6.00				0.970	3.0
* "	"				3/11/79		272	272	1.12	7.87			760		56.0	39.5	63.5	27.6	52.0	8.10	3.85	6.10	0.178	1.49	1.43	1.67	<1.0
* "	"				9/11/79		266	265	0.13	7.80			770		57.0	42.5	61.0	27.6			3.22	5.30	0.063	2.48	1.94	2.20	<1.0
* "	"				12/11/79		276	274	0.80	8.07			780	0.23	56.5	52.0	64.0	28.2			3.12	4.60	0.146	0.90	0.710	0.79	<1.0
* "	"				16/11/79		264	268	0.14	7.75			760		56.0	38.0	61.5	26.8	54.0	7.70	3.6	6.60	0.030	2.5	1.98	2.50	<1.0
"	"				22/11/79 09.20		270	269	8.4	7.50			755		62.0		63.0	27.2	56.0	7.25	2.7	8.25	0.08	2.4	2.15	3.10	
* "	"				22/11/79 09:20		255	262	0.20	7.88			755		61.5	36.5	58.0	26.8	57.0	7.65	1.0	4.00	0.145	4.3	1.85	2.05	
* "	"				22/11/79 16:41		258	264	1.32	7.69			760		63.5	36.5	57.0	28.0	56.0	7.75	2.9	4.90	0.03	2.1	1.75	2.00	<1.0
* "	"				25/11/79 19:03		250	258	0.02	7.51			745		56.0	40.5	57.0	26.2	51.0	9.8	3.0	5.00	0.071	1.80	1.05	2.00	

104.

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R **Date compiled:** 15/04/80 **Compiler :** N. RENNIE

Identification Number[1]	Owner or Source	Location			Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon			Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
		Township	Lot	Concession				Inorganic	Organic	Total																			
* OW1	OBSERVATION WELL NO. 1				31/10/79			69.5	20.0	89.5																			0.4
* "	"				3/11/79	4.6	44	66.0	25.5	91.5																			
* "	"				9/11/79			65.0	28.0	93.0																			
* "	"				16/11/79			68.0	24.5	92.5																			
* "	"				22/11/79 09:20			63.0	19.0	82.0																			
* "	"				" 16:41			65.5	27.0	92.5																			0.4
* "	"				26/11/79										<.001	.001	.03	<.005	<.02			.04	.04	<.02	<.01				

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l=1 ppm= 1lb/100,000 Imp. gal ; 1 μg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 1-A

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW1	OBSERVATION WELL NO. 1				31/01/80		313	317	0.24	7.63			640	0.13	20.0	11.5	72.5	32.0	13.2	2.65	0.590	1.03	0.019	0.75	0.13	0.180	<1.0
* OW2	OBSERVATION WELL NO. 2				12/09/79		369			7.80			690		420						0.20	1.40	0.01	<0.1	0.02	0.26	
"	"				18/10/79 11:34		310	298	0.96	7.60			645		32.5	10.0	65.0	35.8	15.6	2.85	0.010	1.26	0.008	0.02	0.001	0.052	2.5
"	"				" 17:44		322	316	* <0.01	7.39			680		* 32.5	* 21.5	71.0	35.0	* 20.0	* 2.20	* 0.370	* 0.97	* 0.009	* 1.40	* 0.034	* 0.043	1.5
"	"				19/10/79 15:07		304	301	* 0.08	7.52			770		* 56.5	* 45.5	73.0	29.4			* 0.355	* 1.51	* 0.83	* 1.97	* 0.013	* 0.059	<1.0
"	"				24/10/79		353	294	0.22	7.55			740		34.5	54.5	88.0	32.4	21.6	1.85	0.010	1.17	0.194	0.95	0.001	0.067	2.0
* "	"				28/10/79		354	344	11.2	7.71			740		46.0	39.5	89.0	32.0	33.0	6.80	0.420	1.50	0.470	0.08	0.022	0.330	2.5

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s)**: GLENELG, LOT 95, CON I W.T.S.R **Date compiled**: 15/04/80 **Compiler**: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			
* OW1	OBSERVATION WELL NO. 1				31/01/80			81.0	169	250																			
OW2	OBSERVATION WELL NO. 2				18/10/79 11:34			78.0	10.5	88.5										2.0		<.25	4.5		9.0	120			
"	"				" 17:44			79.0	13.0	92.0																			
"	"				19/10/79 15:07			70.5	23.0	93.5																			
"	"				24/10/79			75.0	15.0	90.0																			
* "	"				28/10/79			72.0	15.5	87.5					<.001	0.001	0.05	<.005	<.02	0.04		<.03	0.18	<.02	0.03				

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 1-A

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY   Township(s): GLENELG, LOT 95, CON I W.T.S.R.   Date compiled: 15/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* OW2	OBSERVATION WELL NO. 2				31/10/79		313		0.07								71.0	32.6	37.8	3.90		1.40				0.039	2.5
* "	"				9/11/79		291	277	0.44	7.8			770		54.5	49.0	67.0	30.0			2.12	3.10	0.290	0.31	0.004	0.081	1.0
* "	"				22/11/79			264	0.80	7.69			810		75.0	40.0				5.10	2.1	3.30	0.15	1.0	0.30	0.36	<1.0
* "	"				25/11/79		255	264	0.80	7.75			740		57.0	35.0	57.0	27.4	52.0	7.55	2.4	4.00	0.38	1.11	1.00	1.16	
* "	"				31/01/80		304	313	0.64	7.71			665	1.28	26.0	17.0	69.0	31.8	20.4	4.7	1.25	1.67	0.008	0.19	0.073	0.148	<1.0
* OW3	OBSERVATION WELL NO. 3				12/8/79		265	238	0.26	7.9			500		20.0	16.0	54.0	32.0	6.0	4.6	0.3	1.2	.01	<0.1	0.02	0.36	
"	"				18/10/79 18:49		284	265	* <0.01	7.62			530		* 17.0	* 20.0	55.0	35.6	* 5.7	* 4.60	* 0.085	* 1.04	* 0.003	* 0.04	* 0.006	* 0.013	2.5

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

* Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s)**: GLENELG, LOT 95, CON I W.T.S.R. **Date compiled**: 15/04/80 **Compiler**: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
OW 2	OBSERVATION WELL NO. 2				31/10/79			74.5	13.0	87.5																			
* "	"				9/11/79			69.0	19.5	88.5																			0.1 A
* "	"				22/11/79			69.0	21.0	90.0																			0.3
* "	"				26/11/79										<.001	<.03	.04	<.005	<.02			.06	.12	<.02	<.01				
* "	"				31/01/80			78.5	368	465																			
OW 3	OBSERVATION WELL NO. 3				18/10/79 18:49	23.6	77	63.0	12.0	75.0										1.0		<.25	9.0		1.5	110			

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb. A – sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG , LOT 95, CON I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number [1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
OW3	OBSERVATION WELL NO. 3				24/10/79		298	250	0.16	7.67			580		19.5	36.0	62.5	34.4	6.0	3.80	0.005	0.52	0.001	<0.01	0.002	0.03	3.0
* "	"				28/10/79		300	266	0.04	7.88			580		17.0	25.5	61.5	35.6	4.4	3.40	0.010	0.25	0.004	<0.01	0.003	0.003	3.0
* "	"				31/10/79		303		0.16								59.5	37.4	5.1	4.20		0.18				0.005	1.0
* "	"				9/11/79		308	279	0.04	7.83			590		16.5	22.0	60.5	38.0			0.020	0.13	0.002	<0.01	0.009	0.012	<1.0
* "	"				22/11/79		292	300	0.26	7.79			555		13.5	22.0	58.0	35.6	4.0	2.10	0.10	0.15	<0.01	<0.1	<0.05	<0.05	<1.0
* "	"				25/11/79		298	271	0.08	7.76			560		14.5	20.0	60.0	35.8	4.4	2.55	0.040	0.32	0.003	<0.01	0.001	0.017	
* "	"				31/01/80		261	247	0.12	8.06			496	<0.10	9.5	17.0	53.5	31.0	3.6	1.85	0.045	0.43	0.001	0.23	0.003	0.006	<1.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON. I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
OW3	OBSERVATION WELL NO. 3				24/10/79			62.5	15.5	78.0																			
* "	"				28/10/79			67.0	8.5	75.5					<.001	0.001	.03	<.005	<.02	.04		<.03	.46	<.02	.04				
* "	"				31/10/79			68.5	6.0	74.5																			
* "	"				9/11/79			70.0	11.0	81.0																			<0.1[A]
* "	"				22/11/79			66.5	5.0	71.5																			0.2
* "	"				26/11/79																								
* "	"				31/01/80			60.0	400	460					<.001	<.001	<.02	<.005	<.02			:06	.38	<.02	<.01				

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MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

T.T.T.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

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County: GREY **Township(s):** GLENELG, LOT 95, CONC.I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW4	OBSERVATION WELL NO. 4				12/09/79		374			8.1			710		72.0						0.2	2.2	0.01	<0.1	<0.02	0.58	
"	"				19/10/79		478	287	*0.02	7.58			755		*59.0	*25.5	89.0	62.0	*11.2	*1.5	*0.040	*1.70	*0.007	*0.04	*0.006	*0.035	27.5
"	"				24/10/79		373	294	0.20	7.68			735		43.0	41.0	81.5	41.2	10.1	1.65	0.115	1.12	0.006	<0.01	0.001	0.037	12.5
* "	"				28/10/79		383	295	0.07	7.86			755		42.5	51.5	85.5	41.2	9.5	1.80	0.175	1.24	0.006	0.01	0.002	0.012	18.5
* "	"				31/10/79		369		0.24								78.5	42.0	8.9	1.60		0.64				0.016	12.0
* "	"				9/11/79		372	297	0.13	7.83			720		34.0	61.0	83.0	40.0			0.205	0.95	0.002	<0.01	0.004	0.013	1.0
* "	"				12/11/79		375	296	0.06	7.90			720	0.10	32.0	54.0	84.0	40.0			0.185	1.37	0.004	0.04	0.004	0.013	7.0
* "	"				22/11/79		335	279	0.59	7.83			640		28.5	17.0	69.0	39.4	3.8	2.1	0.1	0.60	<0.01	<0.1	<0.05	<0.05	2.5
* "	"				25/11/79		330	296	0.01	7.81			645		25.5	21.0	69.5	38.0	9.8	1.50	0.110	0.51	0.002	<0.01	0.001	0006	

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SHEET 2

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Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
OW4	OBSERVATION WELL NO. 4				19/10/79	51	150	74.5	31.5	106																			
"	"				24/10/79			73.0	23.0	96.0																			
* "	"				28/10/79			74.0	23.5	97.5					<.001	0.007	.04	<.005	<.02	.04		<.03	.20	<.02	.06				
* "	"				31/10/79			78.0	12.5	90.5																			
* "	"				9/11/79			75.0	14.0	89.0																			<0.1 A
* "	"				12/11/79			76.0	15.0	91.0																			0.3
"	"				22/11/79			75.0	18.5	93.5																			
* "	"				26/11/79										<.001	.008	.03	<.005	<.02			.06	0.18	<.02	0.18				

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County: GREY   Township(s): GLENELG, LOT 95, CON. I W.T.S.R.   Date compiled: 15/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* OW4	OBSERVATION WELL NO. 4				31/01/80		334	293	0.15	8.09			642	<0.10	20.0	39.0	75.0	35.6	8.2	1.30	0.085	0.76	0.002	0.28	0.006	0.012	3.0
* OW5	OBSERVATION WELL NO. 5				12/9/79		700	259	0.54	7.7			1410		128	340	160.0	73.0	47.0	5.4	0.4	1.8	0.32	0.88	<0.02	0.22	
"	"				19/10/79		437	291	* 0.02	7.66			900		* 91.0	* 52.0	76.0	60.0	* 24.6	* 2.30	* 0.230	* 0.79	* 0.011	* 0.11	* 0.001	* 0.004	5.5
"	"				24/10/79		349	286	0.24	7.56			730		48.0	35.0	82.5	34.6	24.6	1.45	0.030	0.72	0.004	0.31	0.001	0.040	<1.0
* "	"				28/10/79		338	290	0.05	7.71			760		54.0	36.0	74.0	37.2	33.0	1.80	0.025	0.84	0.141	0.05	0.001	0.016	3.5
* "	"				31/10/79		334		0.18								77.0	34.4	41.5	2.20		0.80				0.035	1.0
* "	"				9/11/79		280	283	0.07	7.74			758		55.5	37.5	63.5	29.4			1.42	2.70	0.023	0.02	0.003	0.044	1.0

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SHEET 2

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County: GREY **Township(s):** GLENELG, LOT 95, CON. I W.T.S.R. **Date compiled:** 15/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
OW4	OBSERVATION WELL NO. 4				31/01/80			72.5	228	300																			
OW5	OBSERVATION WELL NO. 5																												
"	"				19/10/79	11.2	56	72.5	13.0	85.5										1.0		<.25	3.0		1.0	95			
"	"				24/10/79			73.5	14.0	87.5																			
* "	"				28/10/79			73.0	17.0	90.0					<.001	0.001	.04	<.005	<.02	.06		<.03	.16	<.02	.08				
* "	"				31/10/79			73.5	14.0	87.5																			
* "	"				9/11/79			74.0	12.5	86.5																			0.1[A]

[1] Location is shown in Figure 2; N.D. – Not Detected; P – Present; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 μg/l = 1 ppb. A – sampled on November 3, 1979.

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SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

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County: GREY Township(s): GLENELG, LOT 95, CON I W.T.S.R. Date compiled: 16/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW5	OBSERVATION WELL NO. 5				12/11/79		291	285	0.06	7.81			770	<0.10	56.5	40.0	66.5	30.4			1.58	3.15	0.020	0.02	0.002	0.037	1.5
* "	"				22/11/79		285	272	0.62	7.82			770		59.0	37.0	62.0	31.6	50.0	2.65	2.4	3.20	0.12	1.7	<0.05	0.05	<1.0
* "	"				25/11/79		287	278	0.16	7.77			765		59.5	36.0	60.0	33.2	49.5	4.50	2.2	3.25	0.58	1.00	0.004	0.029	
* "	"				31/01/80		282	290	0.18	7.87			660	<0.10	33.0	18.0	60.0	32.0	28.8	2.90	0.825	1.40	0.078	1.75	0.003	0.010	<1.0
* OW6	OBSERVATION WELL NO. 6				12/9/79		406			7.8			810		84.0						0.2	0.4	0.01	<0.1	<0.02	0.08	
"	"				18/10/79 11:34		296	296	0.86	7.49			585		17.5	10.0	70.0	29.4	11.8	1.35	0.015	0.98	0.064	0.06	<0.001	0.042	2.0
"	"				" 18:12		373	320	* <0.01	7.35			715		* 25.5	* 32.0	91.5	35.0	* 17.0	* 1.45	* 0.030	* 0.30	* 0.018	* 0.31	* 0.004	* 0.010	1.5

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
* OW5	OBSERVATION WELL NO. 5				12/11/79			71.5	16.0	87.5																			
* "	"				22/11/79			70.5	15.0	85.5																			0.3
* "	"				26/11/79																								
* "	"				31/01/80			68.5	222	290					<.001	<.001	<.02	<.005	<.02			.06	.20	<.02	<.01				
OW-6	OBSERVATION WELL No. 6				12/9/79																								
OW6	OBSERVATION WELL NO. 6				18/10/79 11:34			85.0	9.0	94.0										1.5		<.25	3.5		1.0	110			
"	"				" 18:12			88.0	6.0	94.0																			

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
OW6	OBSERVATION WELL NO. 6				19/10/79		381	350	* 0.03	7.40			680		* 26.0	* 19.0	83.0	42.0			* <0.005	* 0.260	* 0.018	* 0.51	* 0.010	* 0.012	<1.0
"	"				24/10/79		323	275	0.36	7.44			740		50.6	43.0	81.5	29.0	39.5	1.20	<0.005	1.06	0.107	0.70	<0.001	0.047	1.0
* "	"				31/10/79		284		0.24								66.0	28.8	47.5	2.50		1.21				0.033	<1.0
* "	"				9/11/79		268	271	0.03	7.72			740		56.0	35.0	61.0	28.0			1.35	2.15	0.500	1.10	0.002	0.043	<1.0
* "	"				16/11/79		284	275	0.24	7.77			762		54.5	36.0	67.0	28.2	50.0	3.40	1.70	2.90	0.28	2.3	0.004	0.053	<1.0
"	"				22/11/79 9:20		329	273	38.0	7.45			778		66.5		104	32.0	53.0	6.00	2.0	2.50	0.24	1.8	0.20	0.70	
* "	"				27/11/19 9:20		278	273	0.30	7.99			780		67.0	34.5	63.0	29.2	55.5	4.75	2.2	2.95	0.22	2.0	0.001	0.053	
* "	"				" 14:29		275	275	0.60	7.70			799		68.5	37.5	61.0	29.8	41.8	1.95	2.4	3.70	0.03	2.2	<0.05	0.08	<1.0
* "	"				25/11/79		257	267	0.52	7.75			800		73.5	35.5	58.5	27.0	64.5	4.25	0.60	3.18	0.37	1.08	0.006	0.066	

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON. I W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
OW6	OBSERVATION WELL NO. 6				19/10/79			85.5	6.5	92.0																			
"	"				24/10/79			70.0	19.0	89.0																			
* "	"				31/10/79			70.5	14.5	85.0																			
* "	"				9/11/79			69.0	14.5	83.5																			0.1 A
* "	"				16/11/79			71.0	17.0	88.0																			
* "	"				22/11/79 9:20			67.5	16.5	84.0																			
* "	"				" 14:29			69.5	18.0	87.5																			0.3
* "	"				26/11/79										<.03	.007	.26	<.005	<.02			<.03	.90	<.02	<.01				

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - Sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW6	OBSERVATION WELL NO. 6				31/01/80		326	316	0.26	7.77			640	<0.10	21.5	13.0	76.0	33.0	13.7	2.6	0.515	0.94	0.005	0.28	0.003	0.015	<1.0
* OW7	OBSERVATION WELL NO. 7				12/09/79		388	349	0.46	7.7			790		64.0	13.0	77.0	48.0	23.0	3.5	0.2	0.4	0.01	<0.1	<0.02	0.20	
"	"				18/10/79		343	350	* <0.01	7.39			660		* 24.0	* 9.0	82.0	33.6	* 15.2	* 1.95	* 0.010	* 0.18	* 0.001	* <0.01	* 0.001	* 0.001	<1.0
"	"				24/10/79		319	284	2.40	7.43			740		53.0	35.5	80.0	29.0	42.5	2.40	0.045	1.23	0.010	1.00	0.018	0.158	<1.0
* "	"				31/10/79		277	.	0.18								64.5	28.2	48.0	4.50		3.05				0.053	<1.0
* "	"				9/11/79		264	275	0.03	7.75			760		56.0	34.0	59.0	28.2			2.88	4.25	0.129	2.07	0.004	0.055	<1.0
* "	"				16/11/79		281	282	0.08	7.78			782		54.5	35.0	65.0	28.8	52.0	5.80	3.0	4.55	0.070	3.8	0.003	0.077	<1.0

[1] Location is shown in Figure 2; N.D. – Not detected; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
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SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 5, CON I W.T.S.R. **Date compiled:** 16/04/80 **Compiler :** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
OW6	OBSERVATION WELL NO. 6				31/01/80			80.5	400	480																			
OW7	OBSERVATION WELL NO. 7				18/10/79	13.0	63.0	86.0	5.0	91.0										1.0		< .25	12.0		5.0	280			
"	"				24/10/79			72.0	17.5	89.5																			
* "	"				31/10/79			71.5	16.5	88.0																			
* "	"				9/11/79			70.5	18.5	89.0																			0.1[A]
* "	"				16/11/79			73.0	17.0	90.0																			

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY   Township(s): GLENELG, LOT 95, CON. I W.T.S.R.   Date compiled: 16/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW7	OBSERVATION WELL NO. 7				22/11/79		278	281	0.23	7.64			765		59.5	36.0	61.0	30.4	51.0	4.75	2.2	3.35	0.10	1.7	<0.05	<0.05	<1.0
* "	"				25/11/79		257	266	0.84	7.81			755		62.0	33.5	57.5	27.4	56.0	5.45	2.4	3.24	0.076	1.39	0.015	0.058	
* "	"				31/01/80		328	319	0.45	7.85			661	<0.10	26.5	11.5	76.0	33.6	15.2	2.10	0.310	0.70	0.015	0.11	0.007	0.014	<1.0
* OW8	OBSERVATION WELL NO. 8				12/09/79		481			7.9			1000		135						0.10	1.2	0.01	<0.1	<0.02	0.28	
"	"				18/10/79 11:34		329	320	1.32	7.58			690		32.0	7.0	68.0	38.6	13.0	1.45	0.130	0.46	0.008	0.04	0.011	0.048	5.0
"	"				18/10/79 17:51		347	296	* <0.01	7.48			680		* 31.5	* 10.0	76.0	38.0	* 8.3	* 1.55	* 0.130	* 0.50	* 0.010	* 0.16	* 0.010	* 0.019	4.5
"	"				19/10/79		399	318	* <0.01	7.56			715		* 29.5	* 34.0	77.0	50.0	* 13.0	* 1.25	* 0.005	* 0.220	* 0.003	* 0.07	* 0.011	* 0.017	2.0

[1] Location is shown in Figure 2; N.D. – Not detected; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78   * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON. I W.T.S.R **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
* OW7	OBSERVATION WELL NO. 7				22/11/79			71.0	17.0	88.0																			0.3
* "	"				26/11/79										<.001	.008	.02	<.005	<.02			.07	.10	<.02	<.01				
"	"				31/01/80			81.0	19.0	100																			
OW8	OBSERVATION WELL NO. 8				18/10/79 11:34			78.5	8.0	86.5										1.5		<.25	18.0		7.5	320			
"	"				" 17:51			83.5	3.5	87.0																			
"	"				19/10/79			85.0	16.0	101																			

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 μg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 1-A

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I. W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number [1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW8	OBSERVATION WELL NO. 8				24/10/79		382	329	0.44	7.58			720		29.5	27.5	91.0	37.6	12.2	1.40	0.005	0.48	0.001	<0.01	0.001	0.019	2.0
* "	"				31/10/79		377		0.05								86.0	39.4	20.6	1.60		0.30				0.009	<1.0
* "	"				9/11/79		337	308	0.02	7.80			780		48.5	40.0	76.0	35.6			0.015	0.51	0.004	0.02	<0.001	0.008	1.0
* "	"				26/11/79				.07																		
* "	"				31/01/80		316	300	0.26	7.94			675	<0.10	35.5	17.5	71.0	33.6	21.4	1.90	0.630	1.14	0.010	0.16	0.005	0.043	<1.0
* OW9	OBSERVATION WELL NO. 9				12/09/79		487	292	0.70	7.9			1040		165.0	15.0	100.0	58.0	26.0	3.3	<0.1	1.4	<0.01	<0.1	<0.02	0.46	
"	"				19/10/79		362	275	*0.07	7.67			690		*89.0	*14.0	69.0	46.0	*18.6	*2.30	*0.160	*0.90	*0.005	*0.01	*0.002	*0.008	11.5
"	"				24/10/79		335	282	0.22	7.66			699		44.5	27.0	77.5	34.4	14.0	1.60	0.015	0.33	<0.001	<0.01	0.001	0.013	2.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 16/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location Township	Location Lot	Location Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon Inorganic	Carbon Organic	Carbon Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
* OW8	OBSERVATION WELL NO. 8				24/10/79			84.5	17.5	102																			
* "	"				31/10/79			85.0	11.0	96.0																			
* "	"				9/11/79			78.5	8.0	86.5																			<0.1 A
* "	"				26/11/79										<.001	<.001	.03	<.005	<.02			0.07	.86	<.02	<.01				
"	"				31/01/80			75.0	25.0	100																			
OW9	OBSERVATION WELL NO. 9																												
"	"				19/10/79	49	104	69.0	36.0	105										1.0		<.25	5.5		1.0	70			
"	"				24/10/79			71.5	15.5	87.0																			

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* OW9	OBSERVATION WELL NO. 9				31/10/79		347		0.08								80.5	35.4	14.3	1.75		0.46				0.010	3.5
* "	"				9/11/79		326	296	0.03	7.68			705		38.0	31.0	77.5	32.0			0.010	0.76	0.002	<0.01	<0.001	0.083	1.5
* "	"				22/11/79		314	283	0.27	7.64			720		49.0	34.0	73.0	31.8	29.6	1.30	0.100	0.65	<0.01	0.10	<0.05	<0.05	1.0
* "	"				26/11/79				.04																		
* "	"				31/01/80		327	307	0.29	7.92			680	<0.10	37.0	16.5	78.0	32.0	20.0	1.85	0.100	0.72	0.002	0.19	0.005	0.017	<1.0
* OW10	OBSERVATION WELL NO. 10				12/09/79		375			7.9			700		33.0						0.30	0.6	<0.01	<0.1	<0.02	0.18	
"	"				18/10/79 11:34		344	338	2.08	7.36			705		24.5	4.0	79.0	35.6	13.1	0.75	0.050	0.36	0.007	0.02	0.014	0.070	<1.0
"	"				" 17:58		385	367	* 0.04	7.34			705		* 23.5	* 12.0	96.0	35.2	* 8.3	* 1.00	* 0.090	* 0.36	* 0.005	* 0.04	* 0.006	* 0.009	<1.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I. W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
* OW9	OBSERVATION WELL NO. 9				31/10/79			77.0	11.5	88.5																			
* "	"				9/11/79			77.0	12.0	89.0																			<0.1 A
* "	"				22/11/79			73.5	48.5	122																			<0.1
* "	"				26/11/79																								
* "	"				31/01/80			78.5	606	685					<.001	.001	.06	<.005	<.02			.05	1.1	<.02	<.01				
OW10	OBSERVATION WELL NO. 10																												
"	"				18/10/79 11:34			91.5	9.5	101										1.0		<.25	7.5		1.5	55			
"	"				" 17:58			98.0	5.0	103																			

[1] Location is shown in Figure 2 ; N.D. — Not Detected ; P — Present ; < — Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 μg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG , LOT 95 , CON I W.T.S.R **Date compiled:** 18/04/80 **Compiler:** N.RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
OW10	OBSERVATION WELL NO. 10				19/10/79 15:22		459	340	* 0.02	7.40			720		25.0	* 29.0	98.5	51.6	* 14.6	* 0.70	* 0.015	* 0.250	* 0.021	* 0.44	* 0.003	* 0.011	<1.0
* "	"				24/10/79		279	274	0.18	7.37			740		52.0	36.5	68.0	26.4	45.5	2.05	1.56	2.90	0.007	0.87	0.002	0.164	<1.0
* "	"				31/10/79		325		0.70								82.0	29.2	47.5	5.55		3.70				0.090	<1.0
* "	"				9/11/79		268	279	0.92	7.77			770		56.7	37.5	60.5	28.4			3.50	4.30	0.32	1.9	0.011	0.076	<1.0
* "	"				22/11/79		286	283	0.54	7.67			779		59.0	34.0	63.0	31.2	48.0	4.65	2.3	3.35	0.20	1.8	<0.05	0.05	<1.0
* "	"				26/11/79				0.70																		
* "	"				31/01/80		346	344	0.37	8.08			690	<0.10	26.0	8.0	83.5	33.4	14.4	1.20	0.165	0.42	0.006	0.15	0.007	0.015	<1.0
* OW11	OBSERVATION WELL NO. 11				3/11/79																						
* OW12	OBSERVATION WELL NO. 12				12/09/79		338	320	0.23	7.9			660		27.0	14.0	80.0	34.0	17.0	1.9	0.2	1.2	0.10	<0.1	<0.02	0.28	

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s)**: GLENELG, LOT 95, CON I. W.T.S.R. **Date compiled**: 17/04/80 **Compiler**: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
OW10	OBSERVATION WELL NO. 10				19/10/79 15:22			92.5	2.5	95.0																			
* "	"				24/10/79			72.0	22.5	95.0																			
* "	"				31/10/79			73.5	17.0	90.5																			
* "	"				9/11/79			70.5	18.0	88.5																			0.1[A]
* "	"				22/11/79			75.0	19.0	94.0																			0.2
* "	"				26/11/79										<.001	.001	.04	<.005	<.02			.05	.20	<.02	<.01				
"	"				31/01/80			87.0	158	245																			
* OW11	OBSERVATION WELL NO. 11				3/11/79																								0.1

129.

[1] Location is shown in Figure 2 ; N.D. — Not Detected ; P — Present ; < — Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY | Township(s): GLENELG, LOT 95, CON I W.T.S.R. | Date compiled: 7/04/80 | Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW12	OBSERVATION WELL NO. 12				31/01/80		327	323	0.08	7.79			662	<0.10	28.0	7.5	75.0	33.8	16.6	0.95	0.010	0.12	0.011	0.18	0.002	0.002	<1.0
* OW13	OBSERVATION WELL NO. 13				16/11/79		286	273	0.18	7.62			770		52.0	34.0	68.0	28.2	47.5	2.45	0.745	1.68	0.032	3.12	0.004	0.034	<1.0
* "	"				25/11/79		275	263	0.13	7.64			780		71.5	29.0	63.0	28.6	53.5	2.90	0.805	1.36	0.113	3.7	0.002	0.038	<1.0
* "	"				31/01/80		326	322	0.09	7.81			662	<0.10	29.0	8.5	75.5	33.4	16.8	1.85	0.010	0.32	0.001	0.38	0.002	0.004	2.0
* OW14	OBSERVATION WELL NO. 14				12/09/79		361	344	0.18	7.80			670		22.0	11.0	80.0	39.0	13.0	3.8	0.1	1.8	<0.01	<0.1	<0.02	0.26	

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler :** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
* OW12	OBSERVATION WELL NO. 12				31/01/80			78.5	8820	8900																			<0.1 A
* OW13	OBSERVATION WELL NO. 13				16/11/79			72.5	10.0	82.5																			
* "	"				25/11/79			68.0	15.0	83.0																			
* "	"				31/01/80			80.5	1040	1120																			
* OW 14	OBSERVATION WELL NO. 14				12/09/79																								<0.1 A

131.

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb. A – sampled on November 3, 1979.

* Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I, W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW14	OBSERVATION WELL NO. 14				25/11/79		322	319	0.13	7.63			665		23.0	15.0	72.0	34.4	14.1	1.70	0.350	0.62	0.006	0.04	<0.001	0.003	3.0
* "	"				31/01/80		307	302	0.22	7.86			622	<0.10	25.5	8.0	70.5	31.8	13.6	1.35	0.150	0.39	0.002	0.23	0.002	0.013	3.0
* OW15	OBSERVATION WELL NO. 15				12/09/79		384			8.1			650		24.0									<0.1			
* "	"				25/11/79		322	310	0.05	7.74			630		18.0	12.5	72.0	34.4	11.0	0.70	0.020	0.23	0.001	0.18	<0.001	0.002	<1.0
* OW16	OBSERVATION WELL NO. 16				25/11/79		391	353	0.16	7.52			720		25.5	11.0	87.0	37.2	11.2	0.75	0.040	0.27	0.002	0.03	0.002	0.004	<1.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I, W.T.S.R **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location			Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon			Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
		Township	Lot	Concession				Inorganic	Organic	Total																			
* OW14	OBSERVATION WELL NO. 14				25/11/79			84.5	9.5	94.0																			
* "	"				31/01/80			77.0	893	970																			
* OW15	OBSERVATION WELL NO. 15				25/11/79			94.0	2.0	96.0																			A <0.1
* OW16	OBSERVATION WELL NO. 16				25/11/79			72.5	9.0	81.5																			A <0.1

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* OW16	OBSERVATION WELL NO. 16				31/01/80		317	310	0.30	7.77			618	<0.10	19.5	7.5	77.0	30.2	10.4	0.75	0.050	0.34	0.001	0.30	0.003	0.005	<1.0
* OW18	OBSERVATION WELL NO. 18				31/10/79		317		0.06								70.0	34.4	40.0	1.70		0.63				0.014	<1.0
* "	"				9/11/79		281	283	0.04	7.74			758		53.0	35.0	66.0	28.2			1.05	1.84	0.062	1.61	0.002	0.029	< 1.0
* "	"				22/11/79		292	272	0.18	7.63			780		61.0	37.0	67.5	30.0	48.0	3.40	1.10	2.05	0.31	3.4	<0.05	<0.05	<1.0
* "	"				26/11/79				0.03																		
* "	"				31/01/80		315	315	0.08	7.77			640	<0.10	19.0	12.0	75.0	31.0	16.8	1.05	0.035	0.30	0.003	1.05	0.001	0.006	3.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

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Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

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County : GREY　　Township(s): GLENELG, LOT 95, CON I W.T.S.R.　　Date compiled: 17/04/80　　Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
OW16	OBSERVATION WELL NO. 16				31/01/80			80.5	6270	6350																				
* OW18	OBSERVATION WELL NO. 18				31/10/79			75.5	9.0	84.5					<.001	<.001		<.004	<.004	.009		<.004	<.004	<.004	<.004	.086	<.004	.001	<.004	
* "	"				9/11/79			72.5	9.0	81.5																				0.1[A]
* "	"				22/11/79			69.5	15.0	84.5																				0.2
* "	"				26/11/79										<.001	<.001	<.02	<.005	<.02			<.07	.08	<.02	<.01					
"	"				31/01/80			77.5	1920	2000																				

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.　A - sampled on November 3, 1979.

MOE 0495 11/78　* Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* OW22	OBSERVATION WELL NO. 22				9/11/79		278	267	0.08	7.65			525		5.5	8.5	62.5	29.6			0.045	0.28	0.043	1.65	0.002	0.005	1.0
* TP 1	TEST PIT NO. 1				31/10/79 14:25		267		0.08								58.0	29.6	50.0	5.90		5.35	0.171				<1.0
* "	"				" 21:25		269		0.14								57.0	30.6	47.0	5.00		4.80				0.138	<1.0
* "	"				3/11/79		264	268	0.07	7.70			750		54.5	32.5	60.0	27.6	50.0	6.50	4.35	6.45	0.171	2.7	0.118	0.275	<1.0
* "	" PIEZOMETER				9/11/79		252	262	1.15	7.68			750		55.5	33.0	55.0	27.8			3.45	4.30	0.087	3.92	0.037	0.184	1.0
* "	" OPEN WATER BODY				"		253	261	0.17	7.80			740		55.0	32.0	56.5	27.2			3.65	4.80	0.014	4.14	0.068	0.180	<1.0
* "	"				22/11/79		251	261	1.46	7.78			785		71.0	35.0	54.5	27.8	67.0	3.0	3.1	4.80	0.09	2.5	0.05	0.20	<1.0

[1] Location is shown in Figure 1, 2; N.D. – Not detected; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY   Township(s): GLENELG, LOT 95, CON I W.T.S.R.   Date compiled: 17/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
* OW22	OBSERVATION WELL NO. 22				9/11/79			67.5	5.0	72.5																				
* TP 1	TEST PIT NO. 1				31/10/79 14:25			69.5	20.0	89.5					<.001	<.001		<.004	<.004	.006		<.004	<.004	<.004	<.004	.07	<.004	.001	<.004	
* "	"				" 21:25			68.5	26.0	94.5					<.001	<.001		<.004	<.004	.019		<.004	.042	<.004	.008	.163	<.004	.003	<.004	
* "	"				3/11/79	2.4	49	67.0	19.5	86.5																				0.1
* "	" PIEZOMETER				9/11/79			67.5	31.5	99.0																				
* "	" OPEN WATER BODY				"			72.5	11.5	84.0																				
* "	"				22/11/79			66.5	25.5	92.0																				0.2

[1] Location is shown in Figure 1,2; N.D. – Not Detected; P – Present; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78   * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY Township(s): GLENELG, LOT 95, CON I W.T.S.R. Date compiled: 17/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* TP1	TEST PIT NO. 1				25/11/79		247	258	0.04	7.79			720		54.0	31.5	54.5	27.0	50.5	6.40	3.32	4.60	0.039	1.66	1.20	1.28	
* TP2	TEST PIT NO. 2				31/10/79		344		0.04								87.5	30.4	40.5	1.10		0.58	0.046				<1.0
* "	"				9/11/79		279	274	0.03	7.60			725		52.0	31.0	64.5	28.6			0.065	0.93	0.003	1.63	0.004	0.050	<1.0
* "	"				22/11/79		265	259	0.09	7.58			722		53.0	31.0	61.0	27.2	46.5	2.05	0.6	1.45	0.19	3.6	<0.05	0.11	<1.0
* "	"				25/11/79		253	240	0.05	7.67			595		32.0	20.5	56.5	27.2	26.6	1.45	0.36	0.56	0.044	2.5	0.005	0.025	

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
* TP 1	TEST PIT NO. 1				26/11/79										<.001	<.001	.02	<.005	<.02			.05	<.02	<.02	<.01					
* TP 2	TEST PIT NO. 2				31/10/79			72.5	12.0	84.5					<.001	<.001		<.004	<.004	.019		<.004	.010	<.004	<.004	.080	<.004	.001	<.004	
* "	"				9/11/79			70.5	5.5	76.0																				A <0.1
* "	"				22/11/79			68.0	12.5	80.5																				0.1
* "	"				26/11/79										<.001	<.001	<.02	<.005	<.02			.06	<.02	<.02	<.01					

[1] Location is shown in Figure 2; N.D. — Not Detected; P — Present; < — Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 μg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* TP3	TEST PIT NO. 3				31/10/79		311		0.12								68.5	34.0	7.3	0.70		0.23				0.011	<1.0
* "	"				9/11/79		308	269	0.02	7.68			640		37.0	21.0	69.0	33.0			0.020	0.36	0.001	0.32	0.002	0.018	<1.0
* "	"				16/11/79		309	277	0.05	7.69			700		45.5	27.5	71.0	32.0	30.5	1.40	0.010	0.49	0.001	1.11	0.005	0.017	<1.0
* "	"				22/11/79		285	265	0.09	7.59			675		45.5	27.0	63.0	31.0	29.4	0.75	0.10	0.50	<0.01	1.30	<0.005	<0.005	<1.0
* "	"				25/11/79		287	267	0.01	7.53			705		48.0	28.5	64.0	32.8	39.0	1.50	0.015	0.55	0.002	3.0	0.003	0.013	
* "	"				31/01/80		266	273	0.05	7.75			580	<0.10	21.0	11.0	62.0	27.0	22.8	0.93	<0.005	0.22	0.004	0.81	0.001	0.003	<1.0
* TP 4	TEST PIT NO. 4				31/10/79		314		0.04								76.0	30.0	12.2	0.95		0.06				0.002	<1.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY Township(s): GLENELG, LOT 95, CON I W.T.S.R. Date compiled: 17/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
* TP3	TEST PIT NO. 3				31/10/79			70.0	5.5	75.5					<.001	<.001		<.004	<.004	.009		<.004	<.004	<.004	<.004	.090	<.004	.002	<.004	
* "	"				9/11/79			70.0	10.0	80.0																				<0.1 A
* "	"				16/11/79			73.5	4.5	78.0																				
* "	"				22/11/79			69.0	8.5	77.5																				0.1
* "	"				26/11/79										<.001	<.001	<.02	<.005	<.02			.05	<.02	<.02	<.01					
* "	"				31/01/80			72.0	73.0	145																				
* TP4	TEST PIT NO. 4				31/10/79			70.5	10.5	81.0					<.001	<.001		<.004	<.004	.009		<.004	.007	<.004	<.004	.100	<.004	.002	<.004	

[1] Location is shown in Figure 2; N.D. – Not Detected; P – Present; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

A - sampled on November 3, 1979

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
* TP4	TEST PIT NO. 4				9/11/79		288	268	0.08	7.63			720		52.0	30.5	70.0	27.4			0.015	0.74	0.002	1.72	0.002	0.038	<1.0
* "	"				22/11/79		279	264	0.07	7.56			740		51.0	30.0	65.5	28.0	46.0	1.80	<0.1	1.10	0.27	5.5	<0.05	0.14	<1.0
* "	"				25/11/79		270	254	<0.01	7.64			665		41.0	24.0	62.0	27.8	35.0	1.20	0.190	0.60	0.093	4.2	0.001	0.023	
* TP5	TEST PIT NO. 5				31/10/79		329		0.04								79.0	31.8	12.2	0.95		0.06				0.002	<1.0
* "	"				9/11/79		323	301	0.02	7.65			625		22.0	6.0	80.0	29.8			0.010	0.14	<0.001	0.04	0.007	0.023	<1.0
* "	"				16/11/79		308	297	0.04	7.52			620		23.0	9.0	75.0	29.2	14.3	0.65	0.010	0.16	0.001	0.02	<0.001	<0.001	<1.0
* "	"				22/11/79		288	281	0.09	7.57			590		22.5	9.0	68.0	28.6	13.0	0.70	<0.1	0.20	<0.01	0.1	<0.05	<0.05	<1.0

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY   Township(s): GLENELG , LOT 95 , CON I W.T.S.R.   Date compiled: 17/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
* TP4	TEST PIT NO. 4				9/11/79			70.0	10.0	80.0																				<0.1 A
* "	"				22/11/79			70.5	10.5	81.0																				0.1
* "	"				26/11/79										<.001	<.001	<.02	<.005	<.02			<.03	<.02	<.02	<.01					
* TP5	TEST PIT NO. 5				31/10/79			82.0	5.0	87.0					<.001	<.001		<.004	<.004	.006		<.004	<.004	<.004	<.004	.071	<.004	.001	<.004	
* "	"				9/11/79			79.0	5.0	84.0																				<0.1 A
* "	"				16/11/79			80.5	3.5	84.0																				
* "	"				22/11/79			77.0	6.5	83.5																				<0.1

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[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1lb/100,000 Imp. gal ; 1 µg/l = 1 ppb. A - sampled on November 3, 1979.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

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Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG , LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
* TP5	TEST PIT NO. 5				25/11/79		296	288	<0.01	7.64			580		16.5	9.5	67.5	31.0	9.8	0.50	0.100	0.12	<0.001	<0.01	0.002	0.003	

[1] Location is shown in Figure 2 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

Ministry of the Environment
Ontario

SHEET 2

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				
* TP5	TEST PIT NO. 5				26/11/79										<.001	<.001	<.02	<.005	<.02			<.03	<.02	<.02	<.01				

[1] Location is shown in Figure 2 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

APPENDIX F

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY   Township(s): GLENELG, LOT 95, CON I, W.T.S.R.   Date compiled: 17/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
RSR 1	ROCKY SAUGEEN R. At C.P.R. TRACKS				22/10/79		240	223	0.07	8.18			447		5.0	15.5	53.0	26.4	2.7	1.00	0.010	0.37	0.003	0.84	0.003	0.008	<1.0
"	"				27/10/79		280	256	0.06	8.16			490		5.0	12.0	68.0	26.8	2.0	1.05	<0.005	0.32	0.001	1.49	<0.001	0.001	<1.0
"	"				29/10/79		280	248	0.07	8.06			484		5.5	13.0	68.0	26.8	2.0	0.85	0.005	0.30	0.001	1.40	0.002	0.004	<1.0
"	"				9/11/79		255	240	0.04	7.36			480		6.5	14.0	60.0	25.6	2.9	0.80	0.005	0.25	0.001	1.33	<0.001	0.003	<1.0
"	"				22/11/79		257	236	0.09	8.04			472		5.0	14.0	59.0	26.6	2.2	0.50	0.1	0.30	<0.01	1.3	<0.05	<0.05	<1.0
"	"				31/01/80		281	262	0.05	8.15			520		5.5	12.5	66.0	28.2	2.4	0.80	0.010	0.26	0.002	2.30	0.008	0.013	<1.0
RSR 2	ROCKY SAUGEEN RIVER 50 ft above outfall				6/11/79		255	239	1.49	8.19		0.35	464		5.5	14.0	59.0	26.0	2.6	0.80	0.005	0.28	0.001	0.26	0.004	0.005	<1.0

148.

[1] Location is shown in Figure 1 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY **Township(s):** GLENELG, LOT 95, CON I, W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids
RSR1	ROCKY SAUGEEN RIVER at C.P.R. TRACKS				22/10/79	1.0	12.0	50.0	11.5	61.5				
"	"				27/10/79	0.4	17.0	59.0	9.0	68.0				
"	"				29/10/79			58.5	10.0	68.5				
"	"				9/11/79			57.5	7.0	64.5				
"	"				22/11/79			57.0	8.5	65.5				
"	"				31/01/79			61.5	2.5	64.0				
RSR2	ROCKY SAUGEEN RIVER 50ft above outfall				6/11/79	0.1	24	58.0	9.0	67.0				

Identification Number[1]	Date Sampled D/M/Y	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
RSR1	22/10/79																
"	27/10/79	<.001	0.001	.02	<.005	<.02	<.01	<0.01	<0.03	<.02	<.02	<.01					
"	29/10/79																
"	9/11/79																<0.1
"	22/11/79	<.001	<.03	<.02	<.005	<.02	<.01		<.03	<.02	<.02	<.01	.04				<0.1
"	31/01/79																
RSR2	6/11/79	<.001	<.001		<.004	<.004	0.02		<.004	.010	<.004	<.004	.070	.008	.002	<.004	

149.

[1] Location is shown in Figure 1 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

SHEET 1-A

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY Township(s): GLENELG, LOT 95, CON I W.T.&R. Date compiled: 17/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
RSR2	ROCKY SAUGEEN RIVER 50ft above outfall				9/11/79		260	242	0.12	8.03			480		5.5	13.5	61.0	26.0	2.7	0.90	0.005	0.47	0.001	1.30	<0.001	0.017	<1.0
"	"				22/11/79		258	237	0.08	8.07			474		6.5	14.5	59.5	26.6	3.0	0.75	<0.1	0.30	<0.01	1.2	<0.05	<0.05	<1.0
RSR 3	ROCKY SAUGEEN R. ~300 ft below outfall				6/11/79		259	246	0.07	8.09		1.6	519		12.0	14.5	60.0	26.4	8.0	1.65	0.300	0.96	0.035	1.39	0.168	0.400	<1.0
"	"				9/11/79		260	241	0.06	8.10			481		5.5	13.5	61.0	26.2	2.6	0.90	<0.005	0.27	0.001	1.31	<0.001	0.003	<1.0
"	"				22/11/79		259	236	0.07	8.10			476		6.5	14.5	59.5	26.8	2.8	0.75	<0.1	0.30	<0.01	1.2	<0.05	<0.05	<1.0

150.

[1] Location is shown in Figure 1 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 17/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum	Molybdenum	Titanium	Vanadium	Anionic Detergent
RSR 2	ROCKY SAUGEEN RIVER 50ft above outfall				9/11/79			57.5	8.0	65.5																				
"	"				22/11/79			57.0	8.5	65.5																				<0.1
RSR 3	ROCKY SAUGEEN R. ~300ft below outfall				6/11/79	1.2	20	60.5	11.0	71.5					<.001	<.001		<.004	<.004	.01		<.004	.005	<.004	<.004	.060	.006	.001	<.004	
"	"				9/11/79			57.5	8.5	66.0																				
"	"				22/11/79			58.0	7.0	65.0																				<0.1

[1] Location is shown in Figure 1 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1lb/100,000 Imp. gal ; 1 μg/l = 1 ppb.

MOE 0495 11/78

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: Township(s): Date compiled: Compiler:

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
RSR4	ROCKY SAUGEEN RIVER downstream from Lagoon				22/10/79		241	224	0.09	8.18			454		6.0	15.0	53.0	26.2	3.1	1.2	0.020	0.61	0.002	0.80	0.001	0.010	
"	"				27/10/79		266	244	0.06	8.17			493		6.0	12.0	62.5	26.6	2.4	1.9	<0.005	0.30	0.001	1.41	0.001	0.003	<1.0
"	"				29/10/79		282	248	0.07	8.14			498		6.5	12.0	68.0	27.2	2.8	1.00	0.005	0.29	0.002	1.55	0.003	0.005	<1.0
"	"				9/11/79		260	249		8.11			499		6.5	14.0	60.0	26.6	3.3	1.00	0.010	0.39	0.002	1.60	0.007	0.042	<1.0
"	"				22/11/79		271	249	0.11	8.08			505		8.0	14.5	61.5	28.4	3.7	0.90	<0.1	0.35	<0.01	1.6	<0.05	<0.05	<1.0
"	"				26/11/79		218	197	0.16	7.11			414		6.5	16.0	51.0	22.0	2.9	1.00	0.015	0.43	0.004	0.76	0.006	0.015	
"	"				26/11/79		251	229	0.12	8.07			472		6.5	16.0	58.0	25.8	3.2	1.05	0.015	0.42	0.003	1.46	0.001	0.011	
"	"				31/01/80		282	261	0.04	8.16			518		6.0	12.5	66.0	28.4	2.8	0.75	0.005	0.21	0.002	1.94	0.004	0.006	<1.0

[1] Location is shown in Figure 1 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

SHEET 2

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County : GREY   Township(s): GLENELG , LOT 95 , CON I W.T.S.R.   Date compiled: 17/04/80   Compiler:

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
RSR4	ROCKY SAUGEEN RIVER downstream from lagoon				22/10/79	0.8	9.8	52.0	10.0	62.0																			
"	"				27/10/79	0.5	9.7	58.5	9.5	68.0					<.001	<.001	.04	<.005	<.02	<.01	<.01	<.03	<.02	<.02	<.01				
"	"				29/10/79			59.5	8.0	67.5																			
"	"				9/11/79			60.5	6.5	67.0																			<0.1[A]
"	"				22/11/79			60.0	6.5	66.5																			<0.1
"	"				26/11/79										<.001	<.03	<.02	<.005	<.02	<.01		<.03	<.02	<.02	<.01	<.02			
"	"				26/11/79																								
"	"				31/01/80			62.0	3.0	65.0																			

[1] Location is shown in Figure 1 ; N.D. – Not Detected ; P – Present ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal · 1 µg/l = 1 ppb.

MOE 0495 11/78

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY   Township(s): GLENELG, LOT 95, CON I   W.T.S.R.   Date compiled: 18/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reative	Phosphorus as P: Total	Phenols, in µg/l
P1	POND NW of SEWAGE LAGOON				27/10/79		317	294	0.17	7.47			615		17.0	17.0	83.5	26.2	9.6	1.95	0.005	0.77	0.003	<0.01	0.002	0.022	1.0
"	"				22/11/79		249	243	0.36	7.36			555		39.5	18.0	65.0	21.0	27.6	3.50	0.2	1.48	<0.01	<0.1	0.10	0.23	<1.0
"	"				31/01/80		416	412	5.3	7.07			790		24.0	5.0	109	34.8	18.0	2.50	0.040	2.45	0.008	0.07	0.056	0.455	12.0
P2	POND SOUTH of SEWAGE LAGOON				27/10/79		210	199	0.06	7.95			447		19.5	8.5	51.5	19.8	10.0	1.60	0.010	0.20	0.005	0.86	<0.001	0.001	<1.0

[1] Location is shown in Figure 1 ; N.D. – Not detected   < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF SURFACE WATER

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date compiled:** 18/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location			Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon			Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn				Anionic Detergent
		Township	Lot	Concession				Inorganic	Organic	Total																			
P1	POND NW of SEWAGE LAGOON				27/10/79	2.0	44	75.0	22.5	97.5					<.001	0.001	.02	<.005	<.02	<.01	<0.01	<.03	0.02	<.02	<.01				A <0.1
"	"				22/11/79			57.5	19.5	77.0																			0.1
"	"				31/01/80			111	20.0	131																			
P2	POND SOUTH of SEWAGE LAGOON				27/10/79	1.2	31	48.0	4.5	52.5					<.001	<0.001	.02	<.005	<.02	<.01	<0.01	<.03	<.02	<.02	<.01				

[1] Location is shown in Figure 1 ; N.D. — Not Detected ; P — Present ; < — Refers to less than ; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78

APPENDIX G

SUMMARY OF CHEMICAL ANALYSES OF SEWAGE LAGOON EFFLUENT

SHEET 1-A

Ministry of the Environment

Ontario

SUMMARY OF CHEMICAL ANALYSES OF SEWAGE LAGOON EFFLUENT

All analyses except pH reported in mg/l unless otherwise indicated

County: GREY Township(s): GLENELG, LOT 95, CON I W.T.S.R. Date compiled: 18/04/80 Compiler: N.RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Hydrogen Sulphide as H_2S	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	pH at lab	Apparent Colour, in Hazen Units	Turbidity, in Formazin Units	Conductance, in micromhos/cm-25°C	Fluoride as F	Chloride as Cl	Sulphate as SO4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Nitrogen as N: Free Ammonia	Nitrogen as N: Total Kjeldahl	Nitrogen as N: Nitrite	Nitrogen as N: Nitrate	Phosphorus as P: Dissolved Reactive	Phosphorus as P: Total	Phenols, in µg/l
	SEWAGE LAGOON EFFLUENT				28/05/79																2.2	8.20				1.00	
"	"				27/09/79		278	284	0.05	7.7		8.8	782		60.0		64.0	29.0						0.1			
"	"				18/10/79		257	292	0.02	7.69			790		57.0	34.0	55.0	29.0	61.0	7.40	7.1	12.0	0.41	<0.1	0.10	3.08	<1.0
"	"				19/10/79		256	292	0.12	7.61			790		57.5	35.5	55.0	28.8	53.5	8.35	7.5	11.8	0.33	0.04	2.35	3.04	<1.0
"	"				3/11/79								770			34.0	58.5	27.0	54.0	8.25	6.7	10.0	0.54	<0.1	2.45	2.92	<1.0
"	"				16/11/79		261						765			33.0	60.0	27.0	53.0	8.00	4.8	11.0	0.43	0.5	2.55	3.22	<1.0
* "	"				23/11/79																	3.65				1.44	<1.0
* "	"				25/11/79		246	268	0.02	8.01			730		55.0	32.5	54.5	26.6	51.5	7.60	4.3	6.30	0.04	1.0	2.45	2.75	
"	"				31/01/80		275	327	0.20	7.35			800	0.33		28.5	65.0	27.2	41.0	7.00	13.5	16.1	0.01	<0.1	3.20	3.50	25.0

[1] Location is shown in Figure 1 ; N.D. – Not detected ; < – Refers to less than ; 1 mg/l = 1 ppm = 1 lb / 100,000 Imp. gal ; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

SHEET 2

Ministry of the Environment
Ontario

SUMMARY OF CHEMICAL ANALYSES OF SEWAGE LAGOON EFFLUENT

All analyses except pH reported in mg/l unless otherwise indicated

County : Township(s): Date compiled: Compiler:

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)	Carbon: Inorganic	Carbon: Organic	Carbon: Total	Petroleum Hydrocarbons	Tannins and Lignins	Reactive Silicate as Si	Total Dissolved Solids	Selenium as Se	Arsenic as As	Barium as Ba	Cadmium as Cd	Chromium as Cr	Copper as Cu	Cyanide as CN	Lead as Pb	Manganese as Mn	Nickel as Ni	Zinc as Zn	Aluminum			Anionic Detergent
	SEWAGE LAGOON EFFLUENT				28/05/79	13.6								24															
"	"				27/09/79									<15															
"	"				18/10/79	25.6	104	71.0	33.0	104										<.25		1.0	.30		16.0	1.5			
"	"				19/10/79			71.5	32.5	104																			
"	"				3/11/79	13	464	63.0	34.5	97.5				8.0															
"	"				16/11/79	28		61.0	34.0	95.0				26															
* "	"				23/11/79	6.1		62.0	32.5	94.5				5.0															0.1
* "	"				25/11/79										<.001	<.03	.04	<.005	<.02			<.03	.05	<.02	<.01				
"	"				31/01/80	46	111	84.0	14.0	98.0				36															

[1] Location is shown in Figure 1; N.D. – Not Detected; P – Present; < – Refers to less than; 1 mg/l = 1 ppm = 1 lb/100,000 Imp. gal; 1 µg/l = 1 ppb.

MOE 0495 11/78 * Filtered through glass fiber filter paper (2 microns) except for phenols and carbons.

APPENDIX H

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Ministry of the Environment

Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY   Township(s): GLENELG, LOT 95, CON I W.T.S.R.   Date Compiled: 18/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW1	OBSERVATION WELL NO. 1				18/10/79	A300	35,000	A5000	A 200				
"	"				28/10/79	21,000	270,000	C120,000	A 900				
"	"				20/11/79	G25,000	200,000	190,000	G1500	340			
"	"				26/11/79	11,000	100,000	72,000	2000	OBS			
"	"				31/01/80	<100	<1000	< 1000	<10				
OW2	OBSERVATION WELL NO. 2				18/10/79	< 100	G240,000	C14,000	A100				
"	"				28/10/79	A20	G2,400,000	A800	A90				

[1] Location is shown in Figure 2; < – Refers to less than; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG, LOT 95 , CON I W.T.S.R. **Date Compiled:** 18/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW2	OBSERVATION WELL NO. 2				20/11/79	5100	68,000	71,000	1410	C 32			
"	"				26/11/79	19,000	90,000	109,000	G1500	250			
"	"				31/01/80	110	500	1000	A 10				
OW3	OBSERVATION WELL NO. 3				18/10/79	<100	G240,000	C9000	<100				
"	"				20/11/79	< 10	2000	<100	A10	<4			
"	"				31/01/80	A10	60	230	A10				

[1]Location is shown in Figure 2 ; < – Refers to less than ; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY Township(s): GLENELG, LOT 95, CON I W.T.S.R Date Compiled: 19/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	Pseudomonas aeruginosa	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW4	OBSERVATION WELL NO. 4				18/10/79	<100	G240,000	G17,000	<100				
"	"				20/11/79	<10	44,000	A600	<10	<4			
"	"				31/01/80	<10	100	410	A40				
OW5	OBSERVATION WELL NO. 5				18/10/79	<100	51,000	23,000	A 300				
"	"				20/11/79	480	7,000	11,000	230	< 4			
"	"				31/01/79	< 10	120	430	A 10				

[1]Location is shown in Figure 2; < – Refers to less than; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment

Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG , LOT 95, CON. I W.T.S.R **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	Pseudomonas aeruginosa	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW6	OBSERVATION WELL NO. 6				20/11/79	9700	52,000	103,000	14,600	160			
"	"				31/01/80	A 20	<100	< 100	<100				
OW7	OBSERVATION WELL NO. 7				20/11/79	5200	31,000	45,000	1220	116			
"	"				31/01/80	<10	< 100	<100	<10				

[1] Location is shown in Figure 2 ; < – Refers to less than ; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment

Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG, LOT 95, CON I. W.T.S.R. **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW8	OBSERVATION WELL NO. 8				20/11/79	A 20	26,000	A800	A 30	20			
"	"				31/01/80	<10	210	A 90	A 10				
OW9	OBSERVATION WELL NO. 9				20/11/79	<10	3100	A 100	< 10	< 4			
"	"				31/01/80	<10	610	A10	<10				

[1]Location is shown in Figure 2 ; < – Refers to less than ; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY   Township(s): GLENELG, LOT 95, CON I W.T.S.R.   Date Compiled: 19/04/80   Compiler: N. RENNIE

Identification Number 1	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW10	OBSERVATION WELL NO. 10				20/11/79	2400	19,000	26,000	600	C 36			
"	"				31/01/80	<10	<100	<100	<10				
OW11	OBSERVATION WELL NO. 11				20/11/79	2100	33,000	17,000	450	28			
"	"				31/01/80	A 10	2200	<100	<10				
OW12	OBSERVATION WELL NO. 12				20/11/79	1300	11,000	9000	520	24			
"	"				31/01/80	<10	<100	A100	<10				

167.

[1]Location is shown in Figure 2; < – Refers to less than; > – Refers to greater than.

An accompanying "L" or "G" indicates that the actual density was less than or greater than the number reported.

An accompanying "C" or "A" indicates that the result is a best estimate and is less precise than other determinations.

"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment

Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY Township(s): GLENELG , LOT 95 , CON I W.T.S.R. Date Compiled: 19/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	Pseudomonas aeruginosa	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW13	OBSERVATION WELL NO. 13				20/11/79	470	10,000	3400	400	8			
"	"				31/01/80	<10	500	A300	<10				
OW14	OBSERVATION WELL NO. 14				20/11/79	<10	1500	A100	<10	8			
"	"				31/01/80	<10	700	1200	<10				

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"OBS" indicates that the analysis has been invalidated because of interference problems.

MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG , LOT 95, CON I W.T.S.R. **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW15	OBSERVATION WELL NO. 15				20/11/79	<10	8500	1000	<10	<4			
"	"				31/01/80	<10	40	A30	<10				
OW16	OBSERVATION WELL NO. 16				20/11/79	<10	49,000	C800	A 10	<4			
"	"				31/01	<10	20	A20	<10				

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MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY   Township(s): GLENELG, LOT 95, CON I. W.T.S.R.   Date Compiled: 19/04/80   Compiler: N. RENNIE

Identification Number 1	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
OW18	OBSERVATION WELL NO. 18				20/11/79	810	20,000	7700	420	32			
"	"				31/01/80	<10	200	A800	A20				
TP1	TEST PIT NO. 1				26/11/79	19,000	66,000	91,000	2200	164			
TP2	TEST PIT NO. 2				20/11/79	256	12,000	4000	196	4			
"	"				26/11/79	G600	7000	6400	284	8			

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Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY   Township(s): GLENELG, LOT 95, CON I W.T.S.R.   Date Compiled: 19/04/80   Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
TP3	TEST PIT NO. 3				20/11/79	4	920	6344	<4	<4			
"	"				26/11/79	136	4900	1100	64	<4			
"	"				31/01/80	<4	624,000	<10	4				
TP4	TEST PIT NO. 4				20/11/79	G600	13,000	10,800	552	4			
"	"				26/11/79	A40	2000	1110	A60	4			

171.

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SUMMARY OF BACTERIOLOGICAL ANALYSES OF GROUNDWATER

Number of bacterial colonies per 100 ml

County: GREY Township(s): GLENELG, LOT 95 , CON I W.T.S.R. Date Compiled: 19/04/80 Compiler: N. RENNIE

Identification Number[1]	Owner or Source	Location			Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	Pseudomonas aeruginosa	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
		Township	Lot	Concession									
TP5	TEST PIT NO. 5				20/11/79	<4	800	16	<4	<4			
"	"				26/11/79	<4	440	<4	<4	<4			

172.

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MOE 0496 11/78

APPENDIX I

SUMMARY OF BACTERIOLOGICAL ANALYSES OF SURFACE WATER

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF SURFACE WATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG, LOT 95, CON I, W.T.S.R **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
RSR1	ROCKY SAUGEEN R. at C.P.R. TRACKS				22/10/79	28	2600	280	48				
"	"				20/11/79	64	4900	C290	28	<4			
"	"				31/01/80	<4	210	A10	<4				
RSR2	ROCKY SAUGEEN RIVER 50ft above outfall				20/11/79	A10	2100	A90	<10	<4			
RSR3	ROCKY SAUGEEN RIVER 300 ft below outfall				20/11/79	A10	3800	C370	A10	<4			

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MOE 0496 11/78

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF SURFACE WATER

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number[1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
RSR4	ROCKY SAUGEEN RIVER downstream from lagoon				22/10/79	64	3900	C550	76				
"	"				20/11/79	160	2500	C890	16	<4			
"	"				31/01/80	4	264	88	<4				
P1	POND NW of Sewage Lagoon				20/11/79	570	6600	2800	110	<4			
"	"				31/01/80	<100	5100	<100	<10				

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MOE 0496 11/78

APPENDIX J

SUMMARY OF BACTERIOLOGICAL ANALYSES OF LAGOON EFFLUENT

Ministry of the Environment
Ontario

SUMMARY OF BACTERIOLOGICAL ANALYSES OF SEWAGE LAGOON EFFLUENT

Number of bacterial colonies per 100 ml

County: GREY **Township(s):** GLENELG, LOT 95, CON I W.T.S.R. **Date Compiled:** 19/04/80 **Compiler:** N. RENNIE

Identification Number [1]	Owner or Source	Location: Township	Location: Lot	Location: Concession	Date Sampled D/M/Y	Fecal Coliform Bacteria	Background Bacteria	Coliform Bacteria	Fecal Streptococci Bacteria	*Pseudomonas aeruginosa*	Sulphate Reducing Bacteria	Heterotrophic Bacteria	
	SEWAGE LAGOON EFFLUENT				18/05/79	6600	29,000	C6500	A20	<4			
"	"				21/11/79	117,000	570,000	440,000	6900	PRESENT			
"	"				26/11/79	56,000	540,000	280,000	6600	C528			
"	"				31/01/80	A2000	100,000	48,000	A3000				

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MOE 0496 11/78